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AMERICAN MACHINIST

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Index to Advertisers and Classified Index Following Reading Matter.

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Made as Above ½ and 1 Ton Sizes Made with Single Load Chains.

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The Bearings of the Hoist have GRAPHITE BRONZE BUSHINGS. They are self-lubricating, they require no oil, and will run indefinitely without cutting.

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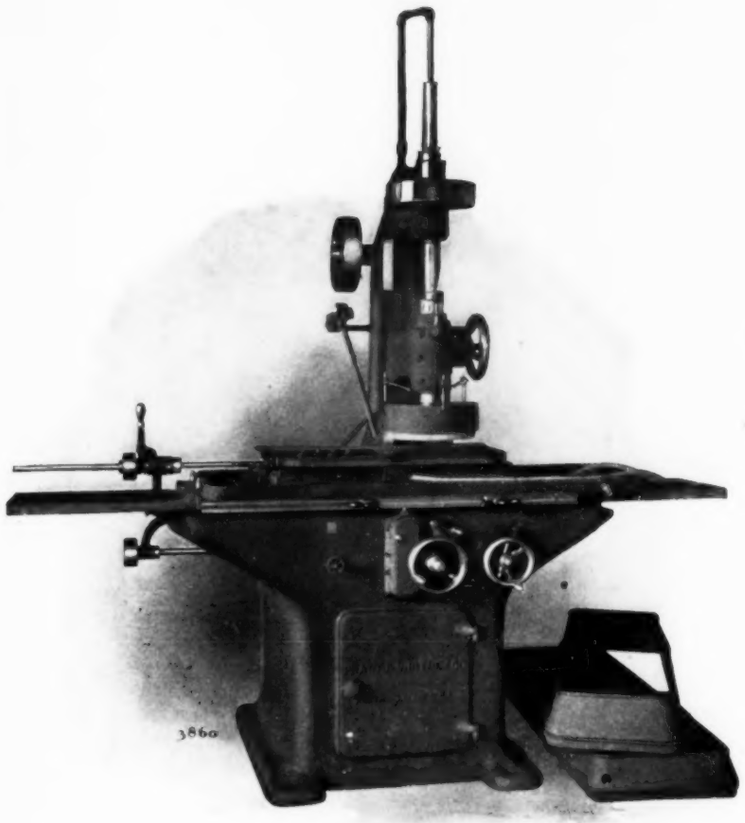

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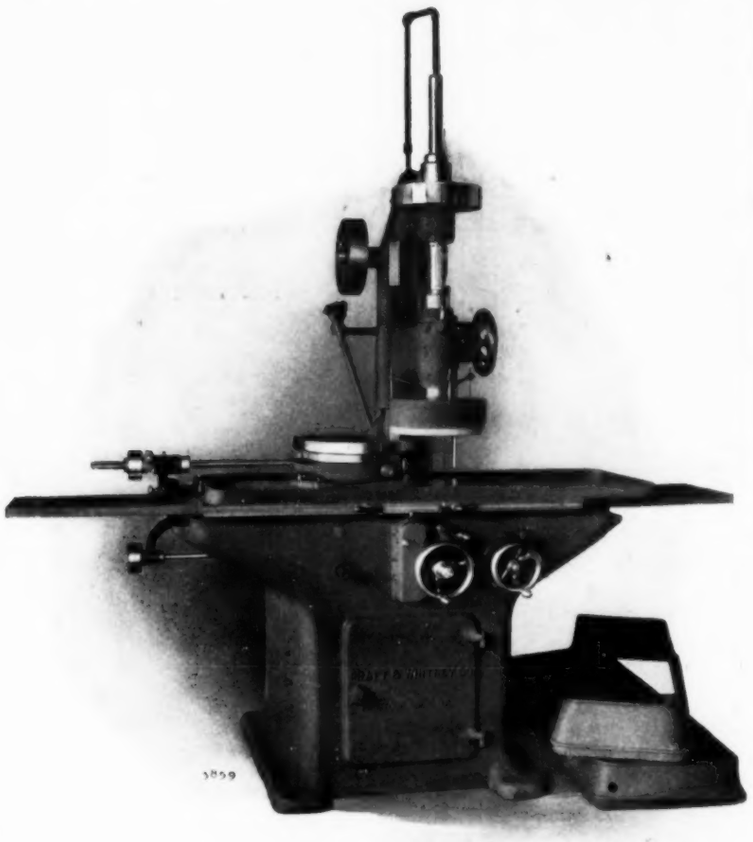


REVOLVING TABLE FOR DISCS, RINGS, COLLARS, ETC., FROM SMALLEST DIAMETER UP TO 16 INCHES.

A Noteworthy Combination Machine Tool

For Slotting, Boring, Drilling and Milling the Various Parts of Heavy Castings for Rolling Mill and Other Large Work at One Setting

SPECIAL CORRESPONDENCE

This machine which has recently been built from new designs is capable of a great variety of work, as will be understood by the name given it. It has a clear distance between posts of 12 feet 2 inches, and a maximum hight of 8 feet 7 inches from top of table to underside of boring spindle. The table is 10 feet wide by 15 ft. 7½ inches long between pans, with bearings consisting of two V's, each 10 inches wide. At frequent intervals in its length are cross girts, making the whole a very rigid casting.

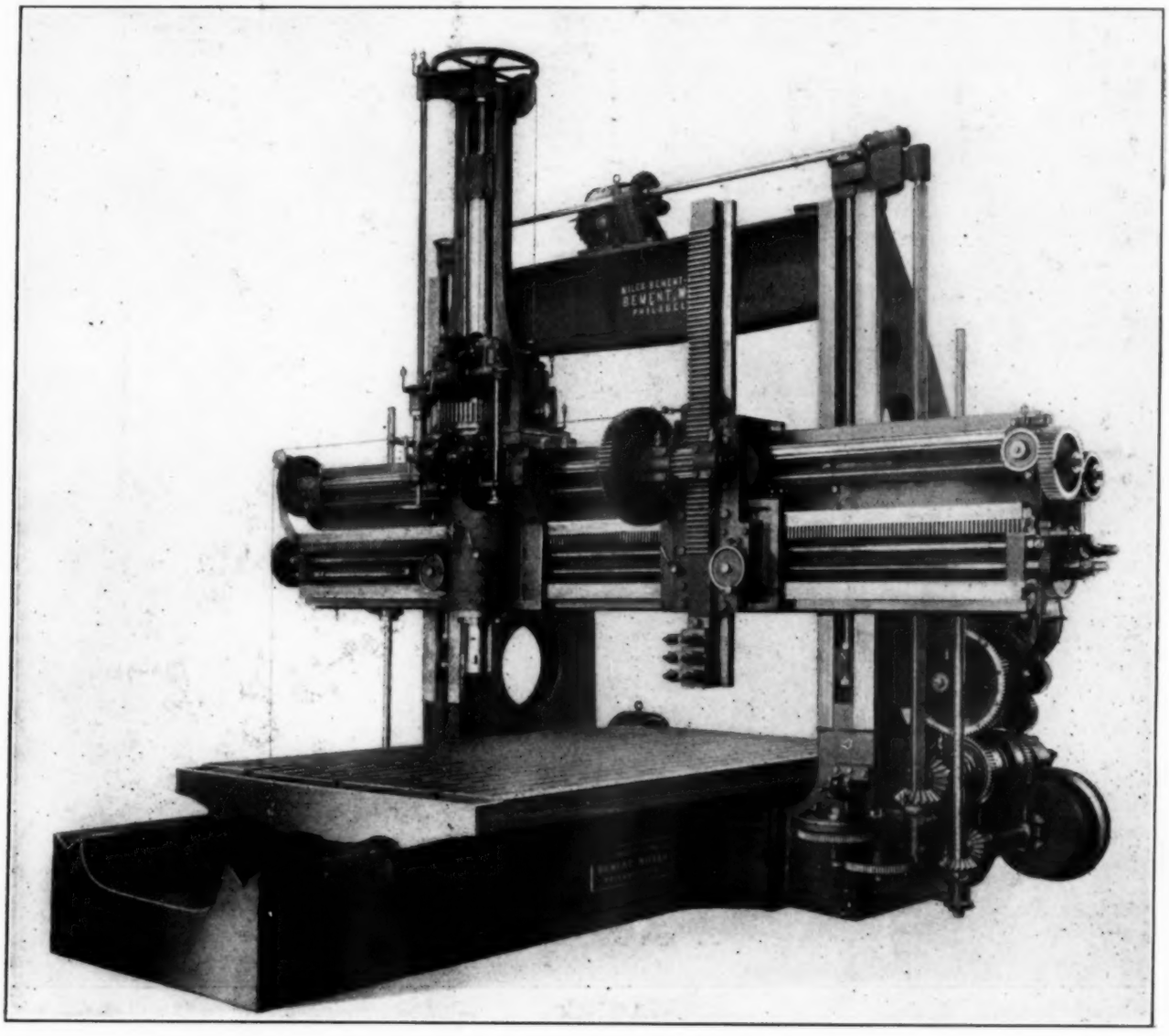


FIG. 1. COMBINED SLOTTING AND MILLING MACHINE FOR LARGE WORK

The bed is a massive cored-out box casting 24 feet 3 inches long, for 50-foot table traverse. At several places in the length of table bearings are oil pockets with rollers for lubricating the table. These pockets are arranged with a system of piping for maintaining the same level of oil throughout. The uprights are cored-out box castings of heavy construction, are keyed and bolted to the side and tied together at the top by an arch in the usual way.

The cross-rail has a 51-inch face, upon which are mounted both the slotting and boring heads. It is supported by two screws of large diameter, one in each post, these being connected to the lifting gear and motor for raising and lowering. This motor is 11½ horse-power, constant speed, giving 17¾-inch movement to rail per minute. The cross-rail is of sufficient length to permit the heads to be placed outside the range of the posts and to permit the traverse of either head for a clear distance between the posts. Total traverse of either head on the cross-rail 16 feet 10 inches.

The slotter head has a wide bearing on the cross-rail. The bar is of cast steel of heavy construction, guided by square locks in the head and is driven by a 25 horse-power variable-speed motor, di-

rectly attached to the side of the right-hand post and equipped with pneumatic clutches for reversing. Power is transmitted from clutches through bevel gearing to the vertical square shaft extending parallel with the upright directly back of the overhanging portion of the cross-rail, then by bevel gearing from the vertical square shaft to the spur gearing on end of cross-rail and connecting with the square shaft shown. On the horizontal shaft and within the saddle is a spur pinion and nut which engages with spur gear at the front, carrying a pinion meshing with rack cut in the front face of the cutter bar.

This bar has speeds of from 19 to 40 feet per minute when cutting, and return of 75 to 90 feet per minute by means of change gearing. The stroke of the bar is controlled by reversing disk at the front of right-hand upright and is directly connected by spur gearing to the vertical square driving shaft. The valve which connects the reversing mechanism of the clutches is operated by dogs on the periphery of the reversing disk. These dogs are adjustable, giving any desired stroke.

The slotter head is fed horizontally on the rail by means of an intermittent feed box with positive drive connecting at the base of right-hand upright to vertical shaft by bevel gearing, this shaft extending parallel with the upright directly back of the overhanging portion of cross-rail, then by bevel gearing to the feed-crank and ratchet gear at end of rail, connecting with steel screw within. The screw is engaged with "open and close" nut in saddle. Intermittent feed to table when slotting is by means of crank and connecting rod on the back end of the feed-box shaft engaging with spur gearing at the back of bed, which in turn connects with a steel screw. A positively engaging clutch and lever are provided for throwing this feed in and out.

The boring and milling head has a wide bearing on the cross-rail. The counterweighted spindle is of steel, has a continuous traverse of 7 feet, and is provided with taper socket at large end. The drive is by a 20 horse-power variable-speed motor attached to the back of the cross-rail engaging with reversing gears on the end and connecting with spline shaft within. The power is transmitted from this shaft by a pair of bevel gears at the back of the saddle gearing with main driving gear directly on the spindle.

Speeds range from 8 1/10 to 36 revolutions per minute. There are four vertical feeds ranging from 0.02 to 0.16 inch per revolution by change gearing attached at the front of saddle and are instantly changeable by a pull pin. The vertical traverse of the spindle is 46 inches per minute by the 3-horse-power constant-speed motor directly attached on front of saddle and geared direct to vertical feed shaft, which engages with screw in spindle by spur gearing at the top. Milling feeds for both the boring spindle and the table are four in number, ranging from 3/8 to 6 inches per minute.

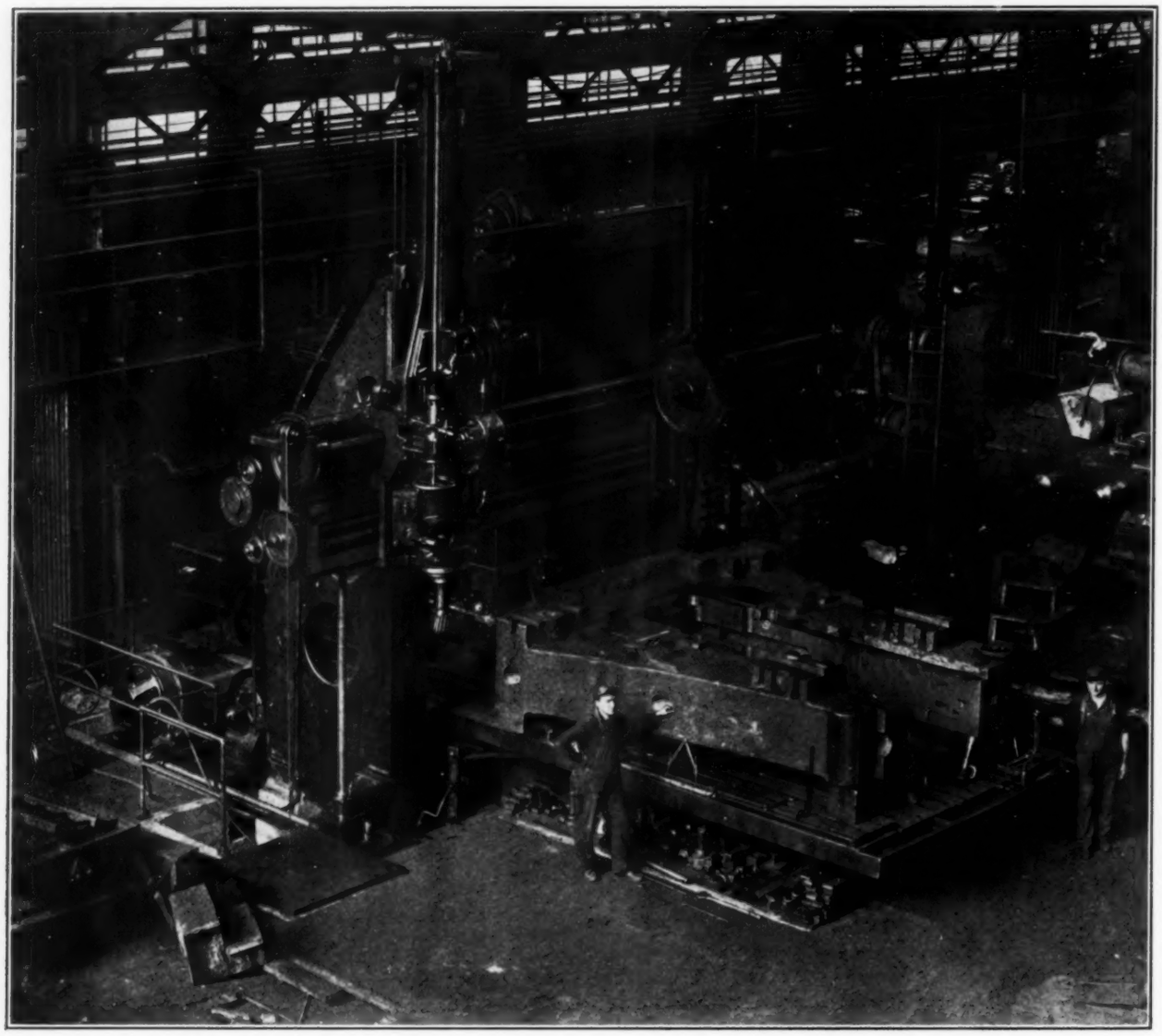


FIG. 2. THE COMBINATION MACHINE AT WORK ON A 68,000-POUND STEEL CASTING

being driven by a 20 horse-power variable-speed motor attached to an extension of the bed at the back of left-hand upright. Milling feeds for the boring saddle are by means of spur gearing from this motor through bevel gearing, connecting with the horizontal feed-shaft extending along the side of the left-hand upright; then by bevels connecting with vertical shaft extending parallel with the upright directly back of the overhung portion of cross-rail and again by bevel gearing to spur gears on end of cross-rail, connecting with screw within, this screw engaging with opening and closing nut in saddle.

The milling feeds for the table are by means of spur gearing from this same motor through bevels to feed-shaft within the extension base, which connects with worm-shaft by change gearing at the back end. Power is transmitted from this shaft through worm gearing to fast traverse and feed-shaft extending along the back of bed, which in turn engages with spur gearing at the back of bed and connecting with the steel screw within. Both the fast traverse to the two heads on the rail and table traverse for the heads to rail and table are through this same motor, being controlled by positive clutch lever, at the rate of 7½ to 15 feet per minute.

One of the first pieces of work for this machine at the Cambria Steel Company plant, Johnstown, Penn., is shown in Fig. 2, and details of this are to be found in Fig. 3. This is the housing for a 48-inch reversing blooming mill and is a steel casting a trifle over 13 feet high by 11 feet 10 inches in width, weighing 68,000 pounds. With this machine one of the housings can be finished at one setting by the combined operations of slotting, boring and milling. The window or opening in the housing, which holds the roll journal boxes, is finished by slotting and by the use of rotary milling tools held in the vertical spindle. These mills are of various diameters and kinds so as to allow finishing the corners of the rabbet in the rounded corners of the window. The various bosses on the face of the housing are finished by milling and bored by the same spindle. The bosses on the lower side are also finished by this spindle, which faces them by undercutting and so avoids turning the housing over.

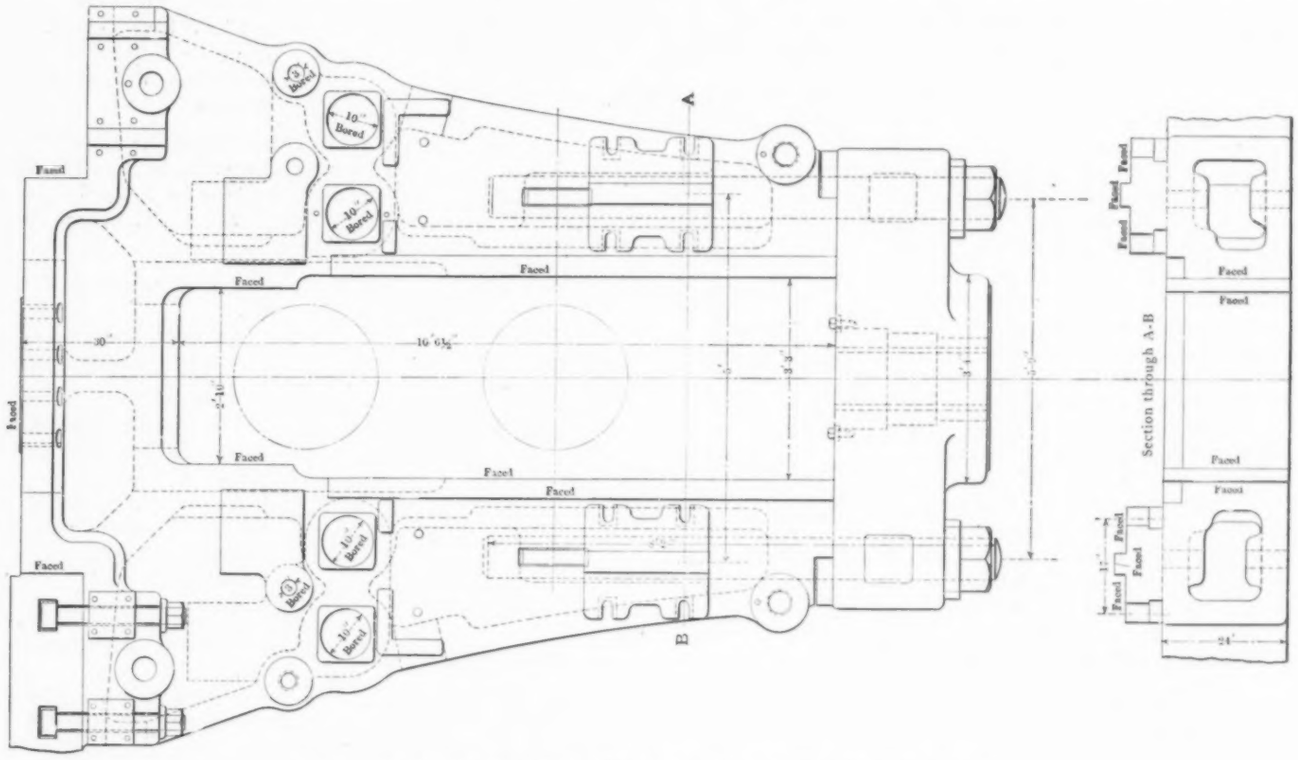


FIG. 3. ONE OF THE BLOOMING MILL HOUSINGS FINISHED AT ONE SETTING

Fig. 2 gives a better idea of the size of this machine, with the work in place than can be given by mere description, and one thing that is noticeable is the goodly supply of blocking and clamping furniture at the side of the bed. A ladder has been built on the back of the housing to facilitate inspection and oiling of the motor and driving mechanism. This machine was built by the Bement works of the Niles-Bement-Pond Company.

On and after October 1, 1908, the rate of letter postage between the United States and Great Britain and Ireland will be 2 cents per ounce, the same as the domestic rate. The same rate is already in effect between this country and Canada (not including Newfoundland), Cuba, Mexico, Panama, and the Philippines.

Direction of Rotation of Epicyclic Gears

By Oscar J. Beale

A very valuable article relative to epicyclic gears is by Prof. A. T. Woods in the American Machinist for February 14, 1889. This article is well nigh perfect. It is so clear and comprehensive that it was of great help to me. I have read a number of later articles, and I have always gone back to this in order to clear up the subject. I think that many of your readers would like to see it reprinted.

About the best way to determine the direction of rotation of epicyclic gears is by careful inspection of the position of the members, then, if you make a correct statement of the effect of each member, Professor Woods' methods will bring the answer right. One must be sure to give the result the proper sign; that is, one must be able to add and to subtract algebraically.

I have sometimes used a sort of mental key in cases like this sketch, page 40. If the pitch circle of L is smaller than the pitch circle of F, the rotation of L will be opposite to that of the arm. If L is greater than F, the rotation of L will be the same as that of the arm.

This "mental key" may help some; but, after all, it is usually better to reason mathematically as in Professor Woods' article.

[We reprint herewith Professor Woods'

article to which Mr. Beale refers because of its value in determining the direction of rotation of epicyclic trains. The article was originally printed in Volume 12, number 7, page 4.—ED.]

EPICYCLIC TRAINS

BY PROF. A. T. WOODS

While there are comparatively few examples of the application of epicyclic trains in modern machinery, they are nevertheless important, in that they furnish simple solutions to some problems in mechanism which could only be solved with difficulty by the common forms of gearing or belting.

An epicyclic train consists of a number of gear wheels, or pulleys, and belts, some of which are carried upon a revolving arm. For example, in Fig. 3, the wheel F is fastened to the shaft B, about which the arm A turns. This arm carries the axes of C and L, C being an idle wheel gearing with F and L. The motion of the wheel L is thus composed of three motions: (1) that which it has by reason of its revolution about B as a center, (2) that due to the revolution of the arm A about F, and (3) that due to its connection with F by means of the wheel C. We will consider the effect of these motions separately, and will begin with the simplest possible arrangement. In Fig. 1, let A be an arm which revolves about a center B, and carries a wheel L, which we will suppose to be fastened to it. If the arm be turned through one revolution, the wheel L will in effect revolve once about its own center. This will be clear by an examination of the successive positions shown in dotted lines, the revolution of the arm being in the direction of the arrow. For example, follow the motion of a point such as P; at 1 it is to the right of the center, at 2 below it, at 3 to the left, and at 4 above the center, finally returning to its first position on the right. We thus see that L has practically made one revolution about its own center, just as it would have if it had been fixed at B concentric with the arm. If L has not revolved by reason of the revolution of A, the point P would have remained horizontally to the right of the center during the revolution of A. This is, of course, the same motion as that of a crank-pin and crank, and will be still more clear if we remember that, if the pin did not in effect revolve about its own center, it would not turn in the brasses, and they could be dispensed with.

Now, considering the second motion of L, that due to the revolution of the arm about F, refer to Fig. 2, and let the wheel F be fixed, or a dead wheel, concentric with the arm A. Let F and L have the same number of teeth. Then while the arm revolves once in the direction indicated, L will revolve in the same direction, the result being the same as if the arm had remained fixed, and F had been revolved once in the opposite direction. The final motion of L, while the arm revolves once, is therefore one revolution, as in Fig. 1, supposing F to be removed, and one revolution, as in Fig. 2, supposing F to be in place and fixed; or, while the arm revolves once, L revolves twice in the same direction.

Now, instead of F being fixed, let it revolve once in the direction of the dotted arrow. The effect of this will be to give one additional revolution to L, resulting in three revolutions of L to one of the arm. In order, then, to get at the resultant motion of the last wheel in epicyclic trains, we must consider the three independent motions separately: *first*, suppose the first wheel F, which is concentric with the arm, to be removed; *second*, suppose the first wheel to be in place and fixed; and third, suppose the arm to be fixed and the first wheel to revolve as intended. The final motion of L is the sum of these three motions.

For the sake of brevity we will designate revolution in the direction of the hands of a watch ahead, or + ; and that in the opposite direction backward, or —. Thus expressed, the revolutions of L in Fig. 2, as we have just discussed it, will be:

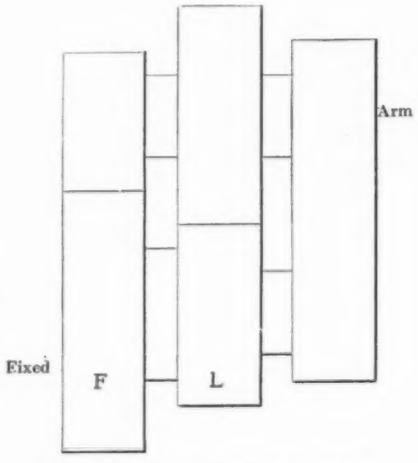


DIAGRAM OF AN EPICYCLIC TRAIN

(a) + 1 due to the revolution of the arm,
+ 1 due to the revolution about F,
+ 1 due to the revolution of F,
+ 3 revolution of L to one of the arm.

As a further illustration assume that in Fig. 2, F has 40 teeth and L 30, then if F is a fixed wheel, L will revolve:

(b) + 1 due to the revolution of the arm,
+ $\frac{40}{30}$ due to the revolution about F,
0 due to the revolution of F,
+ $\frac{7}{3}$ revolutions of L to one of the arm.

If F makes one revolution backward while the arm makes one ahead, we will have for L:

(c) + 1 due to the revolution of the arm,
+ $\frac{40}{30}$ due to the revolution about F,
+ $\frac{40}{30}$ due to the revolution of F,
+ $\frac{11}{3}$ revolutions of L to one of the arm.

If F makes one revolution ahead, or in the same direction as the arm, the result is to balance the effect of the revolution about F, and we have for L:

(d) + 1 due to the revolution of the arm,
+ $\frac{40}{30}$ due to the revolution about F,
— $\frac{40}{30}$ due to the revolution of F,
+ 1 revolution of L to one of the arm, or the same as in Fig. 1. Similarly, if we take the conditions the same as (c) and let F have 30 teeth and L 40, we will have + 2½ revolutions of L to one of the arm.

We will now consider the effect of introducing an idle wheel, as shown in Fig. 3. In the first place, let L equal F, and let F be a fixed wheel. The revolutions of L will be:

(e) + 1 due to the revolution of the arm,
— 1 due to the revolution about F,
0 due to the revolution of F,
0 revolutions of L, or, in other words: a point P, which is, say, vertically over the center of L, will remain so throughout the revolution of the arm. If we assume the same condition as (a), the resulting revolution of L will be:

(f) + 1 due to the revolution of the arm,
— 1 due to the revolution about F,
— 1 due to the revolution of F,
— 1 revolution of L to one of the arm.

If we let F have 40 teeth and L 30, and let F be a dead wheel, we will have for L:

(g) + 1 due to the revolution of the arm,
— $\frac{40}{30}$ due to the revolution about F,
0 due to the revolution of F,
— $\frac{1}{3}$ revolution of L to one of the arm.

Or, reversing the position of the wheels, making $F = 30$ and $L = 40$, the revolutions of L will be:

(h) + 1 due to the revolution of the arm,
— $\frac{30}{40}$ due to the revolution about F,
0 due to the revolution of F,
+ $\frac{1}{4}$ revolution of L to one of the arm.

The arrangement shown at (e) is used in one form of rope-making machinery. The "arm" *A*, Fig. 3, is then the revolving frame which carries the bobbins on which the strands or wire have been wound. *B* is the center of this frame, and on it the wheel *F* is fixed. A small yoke or frame, which carries a bobbin, is fixed on the axis of *L*, there being as many of these wheels and bobbins as there are to be strands in the rope. Then if *F* and *L* have the same number of teeth as at (e), the axes of the bobbins always point in one direction, and the rope is laid up without twisting the separate strands. If *L* has a few less teeth than *F*, the strands will be given a slight twist, making the rope harder.

Arrangements such as Figs. 2 and 3 are applicable to boring bars having sliding head. In such cases *B* would be the dead center on which the bar turns and on which the wheel *F* s fastened, being, therefore, a dead wheel. The wheel *L* is fastened to the end of the feed-screw in the bar, as shown at *S*, in Fig. 4, which represents the end view of the bar. While the arrangement is an epicyclic train, such as we have discussed, the explanation of it is extremely simple, because the motion to be determined is that of the screw *S* *with regard to the bar*, not with regard to the lathe, or any stationary object.

As *F* is fixed, the effect on *L* of one revolution of the bar is the same as if the bar remained stationary and *F* revolved once. Thus, if *F* has 20 teeth and *L* 40, the screw *S* will make, in the bar, 20/40 = ½ of a revolution, while the bar revolves once. And if the screw has four threads to the inch, the feed will be ½ × ¼ = ⅛ inch. The effect of the idle wheel, shown in Fig. 4, is simply to change the direction of the feed.

Another form of epicyclic train is that shown in Fig. 5, in which the last wheel is concentric with the arm and first wheel. This does not change the resultant motion of *L* in any way, but only makes a more convenient form for transmitting motion from *L* to other parts of the machine. If *F* and *L* have 40 and 30 teeth, while the wheels *C* and *D* are equal, we will have the same motion as at (g) and (h), supposing *F* to be a dead wheel. A recent and novel application of this form of train is to be found in the Waterbury watch, the principle of which is shown in Fig. 6. In this figure *a b* is the face of the watch, and *c d* the frame which carries the principal train of wheels, that from *C* to the balance wheel *g*. This frame turns about the center shown below it and the bearing in the face. It is driven by the spring *e* and carries the minute hand *M*, and hence revolves once each hour. Between the frame and the face is a pinion *C*, having 8 teeth, which is connected to the balance wheel *g* by the train of wheels shown, and itself gears with two wheels *F* and *L*, having, respectively, 44 and 48 teeth. *F* is fastened to the face, and so is a dead wheel, and *L* is fastened to the hour hand *H* by the tube, as shown. It remains to show that the hour hand will revolve once in 12 hours, as required by means of this connection. We have here an epicyclic train *F C L* in which the first wheel is fixed. The revolutions of *L* during one revolution of the arm, as we have called it, or the frame *c d* are, therefore:

+ 1 due to the revolution of the arm,
− 44/48 due to the revolution about *F*,
0 due to the revolution of *F*.

+ 4/48 = + 1/12 revolution during one revolution of the arm or minute hand, which is, of course, as it should be. The remainder of the train of wheels in this watch do not differ in principle from that ordinarily employed, a peculiarity being, however, that the entire "works," held in the frame *c d*, revolve within the case every hour.

Another peculiar adaption of epicyclic trains is for the production of very slow velocities, using a small number of wheels. For example, in Fig. 5, let the numbers of teeth on the several wheels be *F* = 19, *C* = 20, *D* = 21, and *L* = 20, and let *F* be a dead wheel. Working out this train as we have the others, it will be found that, while the arm *A* makes one revolution, the last wheel *I* will make but 1/400 of a revolution. In the same way, if we take the number of teeth in order as above, as 27, 40, 37 and 25, the last wheel will make but one revolution, while the arm makes 1000.

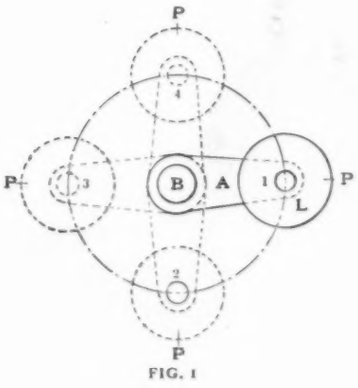


FIG. 1

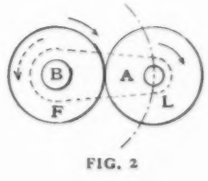


FIG. 2

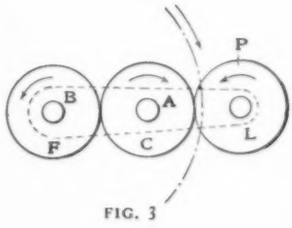


FIG. 3

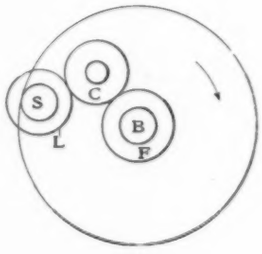


FIG. 4

DIAGRAMS OF EPICYCLIC GEARS

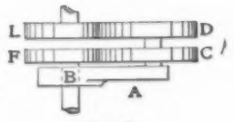


FIG. 5

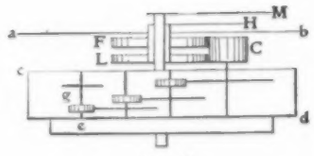


FIG. 6

We have chosen examples in which the first wheel is the dead wheel, as these are the simplest and most common. By adjusting the speed of the first wheel, however, it becomes possible to transmit velocities by means of epicyclic trains, which would be practically impossible by ordinary means. As an illustration, suppose it is required to have one shaft make 641 revolutions to one of another. As 641 is a prime number, this ratio could not be transmitted exactly by ordinary gearing on account of the large number of teeth required for a single wheel; but by means of an epicyclic train it can be readily accomplished. Of course, the necessity for such ratios as this rarely occurs in machinery.

A method of solving problems involving epicyclic trains, which will be more convenient for many than that which we have followed, is by means of a general

formula. Let v = the value of the train of gears, or the product of the number of teeth on the drivers divided by the products of the numbers of teeth on the followers, which would be, in Fig. 5,

$$\frac{F \times D}{C \times L}.$$

In case of pulleys, v = the product of the diameters of the drivers divided by the product of the diameters of the followers. Let f, l and a represent the number of revolutions of the first wheel, last wheel, and arm, respectively, in the same time.

Then,

$$v = \frac{l - a}{f - a}.$$

If one direction is represented as +, the other will be represented as —. If the last wheel is to revolve in the same direction as the first, supposing the arm to be fixed, v is +, and if the opposite direction, it is —. For example, take the data as at (b), then,

$$v = -\tfrac{1}{10} = \frac{l - a}{0 - a}, \text{ whence } l = \tfrac{1}{9}\, a.$$

Again, let it be required that L shall make one revolution to 1000 of A (Fig. 5),

$$v = \frac{1 - 1000}{0 - 1000} = + \frac{999}{1000} = \frac{27 \times 37}{40 \times 25} = \frac{F \times D}{C \times L}.$$

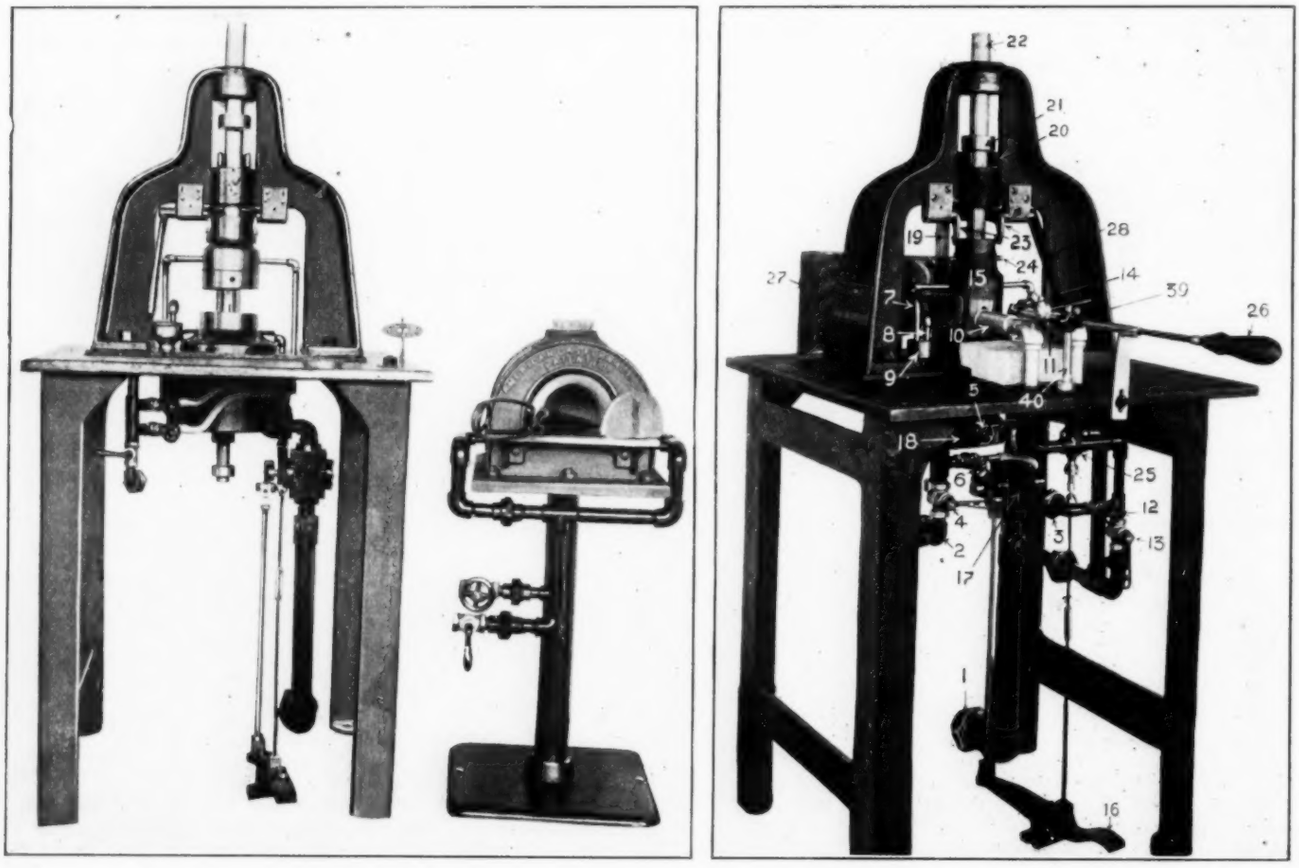
Hardening Thin Pieces of Steel

Everyone who has attempted to harden thin pieces of steel, such as slitting saws or safety-razor blades, knows the difficulties of having them come out of the hardening bath straight enough to lie still on the bench. To obviate this difficulty the American Gas Furnace Company, of New York, have made a number of machines similar to those shown with this and which have several very interesting features. The machine at the left is arranged for hardening thin saws, while the other is for razor blades of the "shave yourself" variety.

Referring to this machine, 1 is the air, 2 the water, and 3 the gas supply. The cock 4 and valves 5 and 6 control the flow of water through the hammers. 7 and 8 are overflows which discharge into an open funnel 9, so that any stoppage of circulation can be detected at once. The burners 10 and 11 are supplied with gas and air by valves 12 and cock 13, the desired regulation being when the bases appear like a steady layer of bluish-green beadlets about 1/16 inch high, the remainder or higher parts of the flames being blue.

When the carrier 14 is heated to a red heat, the blade or other flat article to be hardened is placed on it, and just before the blade is heated to the desired degree, the hammer 15 is raised. This is accomplished by pressure on the treadle 16, which opens the two-way valve 17, admitting air under 1½ pounds pressure into the cylinder 18, raising a piston therein attached to shaft 19, and on this is the fork 20, which engages the collar 21 fast on the hammer stem 22, thus finally raising the hammer 15. When the hammer has reached the top, it is held up by the hooks 23, automatically engaging the pin 24. The spring valve 25 is provided in a branch of the air supply to blow off the hardened blades, and is operated by the same pressure on the treadle 15 which raises the hammer.

The moment the hammer has reached the top the treadle should be released. This opens the other port in the two-way valve, allows the air to escape from the cylinder and the piston-shaft with its fork will fall to its lowest position, the hammer remaining up. This will allow the hammer to drop freely when the time comes to release it with its full weight upon the blade to be hardened. When the blade has been heated to the proper degree for hardening, the carrier handle 26 is pushed forward as far as it will go. This deposits the heated blade on the center of the anvil. Then the carrier handle is drawn back quickly to its original position causing the hammer to drop freely upon the heated



GAS FURNACES FOR HARDENING THIN PIECES

blade where it should remain until just before another blade is heated to the required degree. Then the hammer is raised as before, the blade just hardened being blown into the receptacle 27 by a flattened air nozzle not seen, on the branch controlled by the spring valve 25 mentioned before.

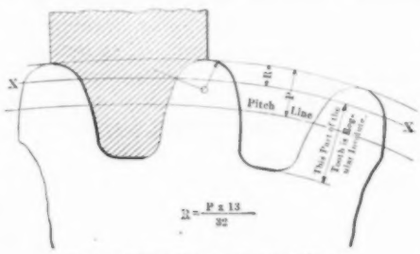
A pin secured in the carrier-rod and traveling in a slot causes the carrier to turn and deposit the blade on the anvil, and by the same means when drawn back it assumes the proper position for receiving another blade to be heated. The handle being free to turn on the carrier-rod, it may be gripped tightly, and not interfere with the twisting of the rod and carrier.

A rod is mounted on the carrier-rod so as to revolve, and is supported by and slides on a horizontal rod, so that when the carrier is moved forward this rod glides over an inclined projection on the lever 28, but when carrier is drawn back, the rod engages the projection, trips the lever, and as the lever and hooks are pinned to the same shaft, the tripping lever releases the hammer allowing it to drop.

At the Hendey Machine Company

Among the interesting tools and appliances at the Hendey Machine Company, Torrington, Conn., is their machine for turning the rims of hand wheels for lathes and milling machines, as shown in Fig. 1. This is practically a lathe head mounted on a shaper column and in place of the regular shaper table or knee is one having a central column carrying a tool slide which operated by the worm and worm gear at the bottom.

The work is mounted on the lathe spindle in the usual way, the tool adjusted so as to give the correct radius, which can be done by the cross-slide on top of the column, and the machine started

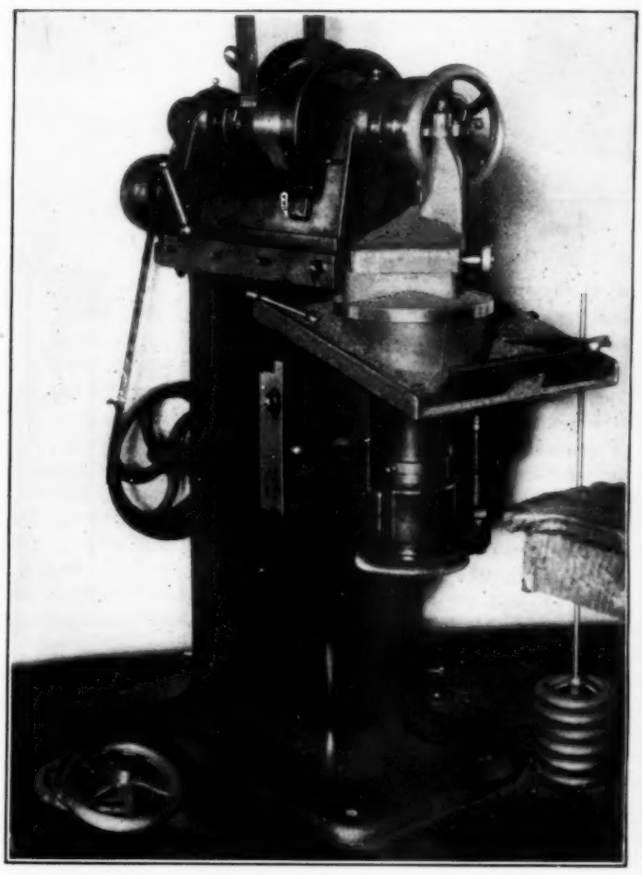


THE ROUNDED-TOP GEAR TOOTH

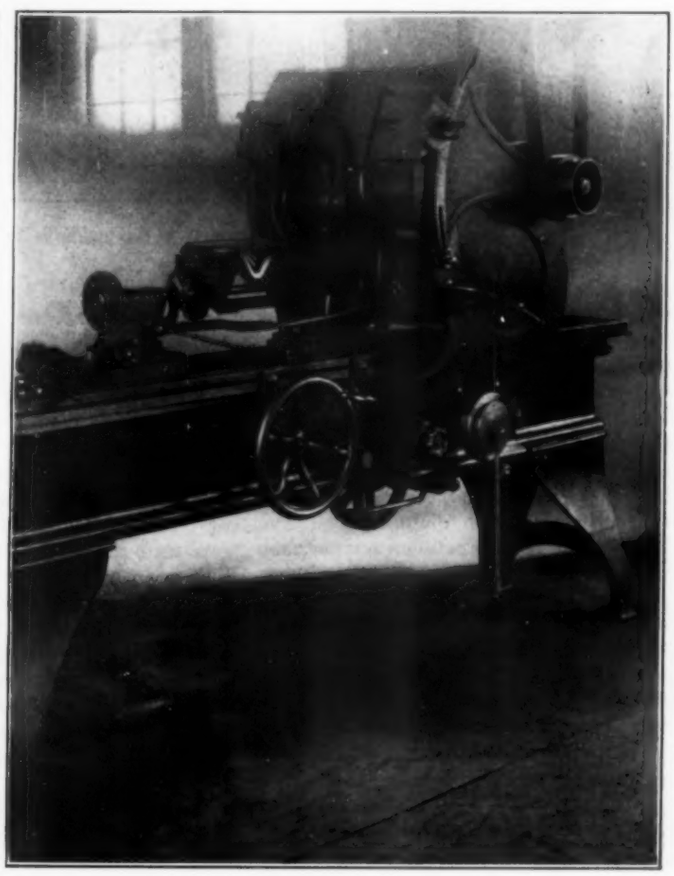
up. The feed is entirely automatic and the tool swings around the outside of the rim of the wheel, making a perfectly true circle and stopping automatically when it has completed its travel. It is a very simple little machine, but one that does its work without any attention except handling the wheel and setting it for a new cut.

Another machine which is somewhat out of the ordinary is shown in Fig. 2 finishing the outside of the change gear case of the well known Hendey-Norton type. The central holes in this are bored and the case mounted on an arbor as shown. As the handle which operates the tumbler gears move in a true arc around the central shaft it is desirable, if not absolutely necessary, that the outer surface of this should be concentric with it, so that the spring plungers may work uniformly in the various holes. It also adds to the attractiveness of the lathe to have this case finished in this way. For this purpose a grinding machine of the planer type was devised as shown, and the work passes back and forth under the wheel, at the same time being turned by the rachet shown connected to the crooked lever in front. With this machine it is an easy matter to finish these in this way, and the cost is low, as the machine is automatic after being started at work.

In experimenting with their new geared heads they have been led to adopt the form of tooth shown in Fig. 3, which is practically the standard involute tooth with the point rounded off as shown. The formula shows the amount of this rounding, which in a way has the effect of making it a short or stub-tooth so far as working surface is concerned. This form of tooth has proved very satisfactory, and runs much more quietly than the regular tooth under the conditions which exist in a geared head. It would be interesting to compare the running of this tooth with teeth having the outer or rounded portion entirely cut away above the line XX.



HAND WHEEL TURNER



GRINDING THE GEAR-BOX COVER

Some Special Tools Used in Italian Shops

Machining Carbureters and Various Sizes of Projectiles in Milan Shops While Holding the Work by Ingenious Expanding Chucks

BY E. DOMON

Having charge of the automatic department of the Italian Branch, in Milan, of the firm of Alfred H. Schutte, I had last year to install a complete plant of machines, tools and fixtures, for a bicycle-motor factory, for a daily output of 60 motors.

Carbureter Fixture

In arranging to machine cast pieces for the carbureter shown to the left in Fig. 1, I had much trouble in clamping the pieces from the inside with a three-jaw chuck: The casting was very thin and became distorted upon the tightening of the jaws; also, the casting being conical inside there were only a few points which were gripped by the jaws, and as soon as it had been turned a short distance, the piece became loose and when the chuck was tightened again, the work would not remain in its original position.

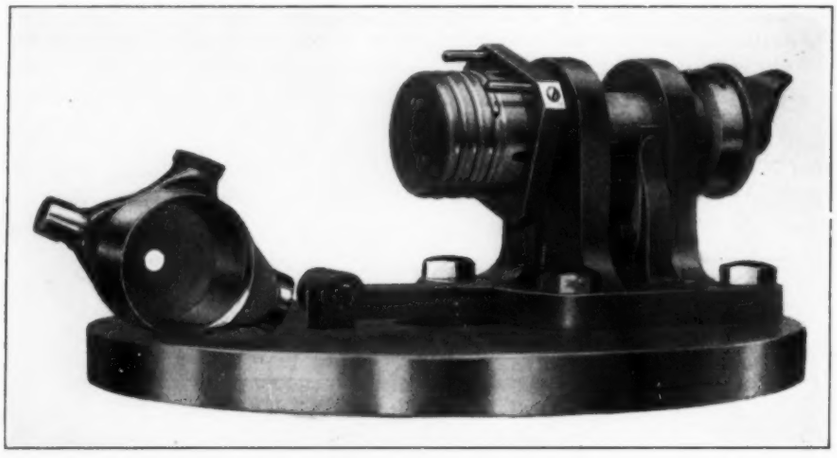


FIG. 1. TURRET LATHE FIXTURE FOR HOLDING CARBURETER

The fixture then devised for holding the piece is a differential expanding chuck serving as a face-plate fixture which is shown in Fig. 1, and the construction of which will be seen in Fig. 2.

The operations to be done on the carbureter consist in drilling, milling and tapping the three openings which are in the periphery of the piece, at an angle of 90 degrees one to another, two of these openings being in the same plane, and the third one at the other end of the piece. These three openings are to be made in one setting on a Warner & Swasey No. 4 machine having six tools in the turret.

Construction of the Fixture

On the nose of this machine is fixed a face plate *A* to which is attached a bracket *B*, Fig. 2. In this bracket is adjusted a spindle *C* which is hardened and ground and in the end of which are slots *D*, corresponding in position to the openings to be machined in the work. *C* is movable lengthwise and can be shifted endwise a distance corresponding exactly to the distance between the different planes of the holes in the cast piece. A blade *E* well supported in slots in each leg of the bracket is pivoted on the lever *F* and forced successively by means of the lever, into each groove of the spindle *C*. The latter can, therefore, be set readily to suit the position of the three openings to be machined.

The clamping device on this fixture is made as follows: The end of the spindle *C* receives two hardened and ground steel rings *G H* which are adjustable, but without any shake. These rings as well as the shoulder of *C* and the head of the central stud *I* have beveled edges and are well polished. In the V-grooves thus formed are three steel piano-wire rings *J*, which are opened by operating the eccentric lever *K*, fixed on the end of *I*. This lever rests against a regulating nurled nut *L* and when moved to the position indicated draws back the head of stud *I* and so compresses the beveled rings *G H* and expands the three piano-wire rings *J* against the interior of the work. The expanding rings thus support the work at three different places and the pressure is equally divided. The number of rings required in a fixture of this type depends upon the length of the piece to be clamped. The device can be made with steps if the work is of such a form as to require this construction. Three pins *M* screwed in spindle *C* and passing through holes in the head of *I* act as stops for locating the casting always in the right position. When placing the work on the fixture the nurled nut *L* is unscrewed until the rings are expanded sufficiently to hold the casting; then with a wooden mallet the eccentric lever *K* is set to the position shown causing the work to be held tight.

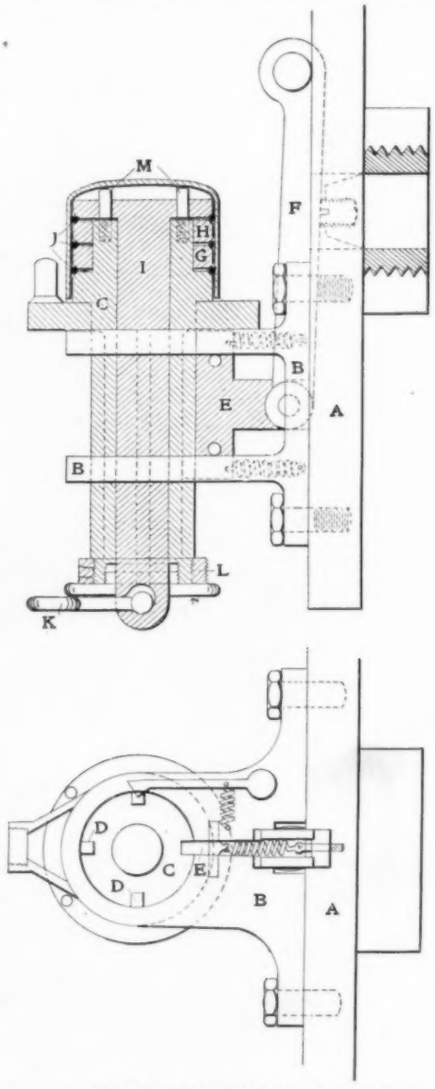


FIG. 2. FIXTURE FOR HOLDING CARBURETER

Finishing Large Projectiles

An important Italian firm making large pressed shells of different sizes, had considerable trouble in handling and finishing these heavy pieces, and asked the firm of Alfred H. Schutte, here in Milan, if they could undertake the arranging of the machinery, tools and equipment complete to make these shells rapidly and accurately.

The problem was a difficult one, so I first examined the method they had been following for doing the work.

These shells are very uneven and the walls are often ½ inch thicker on one side than on the other. The first operation consisted in gripping the outside of the shell in a heavy scroll chuck and centering the other end; but the shell being 3 feet long and weighing 1700 pounds, always dropped at the outer end and they could never bring the center exactly in line with the chamber in the shell.

After the center was formed the tailstock was brought up to the end of the work and the outside was then turned. In the next operation they gripped the shell by the outside and with tools in the turret finished the interior, threaded the rear end and also turned the grooves for the copper rifling band. They had trouble in machining the inside of the work which was always out of center. The central hole was 23 inches deep by 6 inches in diameter, and the long bar on whose end was fixed a cutter to turn to the bottom of the conical hole, always vibrated and deflected so that only light cuts could be taken and the finished hole was never quite central.

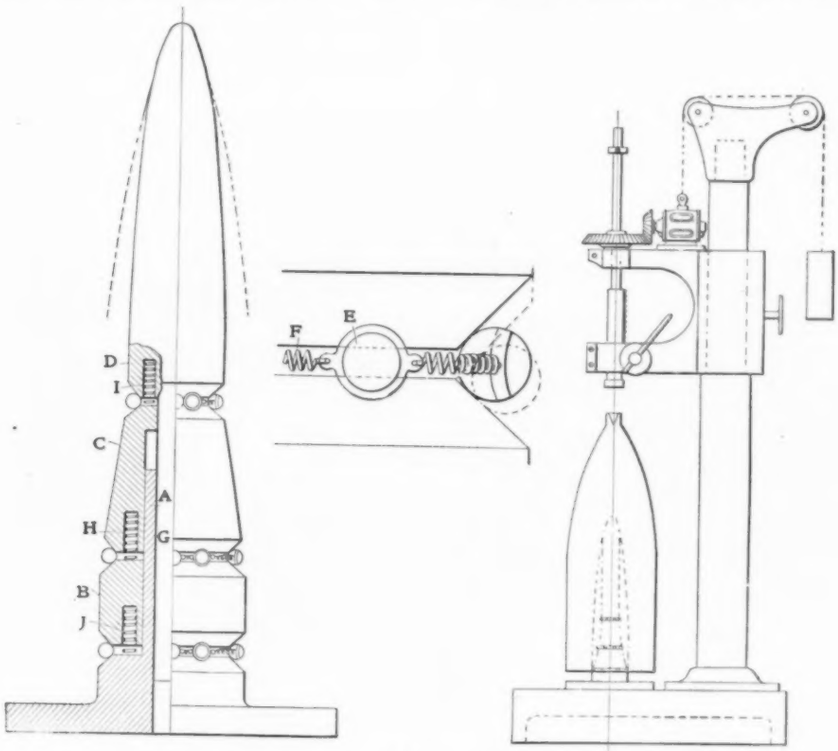


FIG. 3. PROJECTILE CENTERING FIXTURE

A Centering Device

The fixture I had made for the carbureter suggested a method of handling these shells. Instead of putting the shell in the lathe to be centered, I made a vertical fixture to be used under a special drill press, which prevents all trouble in centering the shell. The one fixture has to center three different sizes of shells, the largest being as stated, 36 inches in length and weighing 1700 pounds, while the smallest is 24 inches in length and weighs 550 pounds. In centering the shells vertically the weight, instead of being objectionable as in the horizontal process, becomes of service as it is sufficient to expand the rings which locate the work by the interior.

The fixture is constructed as follows: A tubular upright *A*, Fig. 3, with bore ground true and concentric with the exterior is adapted to be fixed in the base plate of the special drill press. On the outside of this tube *A* are adjusted three steel members *B C D* whose diameters correspond closely to the diameters of the three different sizes of holes in the shells and the facing corners of which are beveled, ground and polished. The steel piano wires used in the fixture for the carbureter are replaced here by steel balls, and small punched rings *E* connected by spiral springs *F* prevent these balls from dropping out of place. A conical plunger *G* having its shank ground, is adjusted nicely in the tube *A*. Spiral springs *H I J* are inserted in a row of holes formed in the faces of parts *B C D* to separate them and so allow the diameter formed by the circle of balls around these steel rings to become smaller and permit the shell to be placed on the fixture. In setting a shell on the plunger its own weight will press together the steel rings, thus expanding the ball circles and centering the shell from the inside. The drill press has a movable head which, when swung around, allows the shell to be placed on the conical plunger. The shell being in place, the head of the drill press is turned back to the right position against a stop, which is so adjusted that it brings the drill exactly in line with the center of the ball circles and the plunger *G*.

Turning the Shells

The first operation in turning these shells is to hold the work internally in a fixture arranged in the same manner as the one for the carbureter, while the other end of the shell is carried by its center. In this way the complete exterior surface is turned and finished, with the grooves for the copper band, perfectly concentric with the interior.

The second part of the operation is to cut away the center. Two rollers fixed on two slides are forced under the shell, the tailstock is drawn back and then with the cross-slide tools the point of the shell is finished.

The next operation is much easier. After the shell has been fixed in a chuck of the same type, but clamping at the outside instead of the inside, a form of hollow mill is used to machine the parallel part of the hole: This is finished with a special mill with movable blades controlled by a conical guide having the same shape as the cone of the shell; with this a coarse cut can be taken.

The time required to center the shell is 10 minutes. The time required to turn the outside and form the grooves for the copper rings, is 3½ hours. The time required to finish the inside complete, cut the thread and form the copper ring is five hours.

The same shells are finished with the improved tools and fixtures twice as fast as with the old process.

Hardening Tools

By Fred Walsleben

My interest was aroused during some early experience by unaccountable failures in hardening, although I had taken every precaution. After making a careful investigation to discover the causes of my troubles, it finally occurred to me that the cause lay wholly in the way the steel was quenched.

Most hardeners said that the hot steel immediately after immersion in the quenching bath, should rapidly be moved about until cold, but I reasoned that the tool in being moved about in the bath was kept at a too uneven temperature, owing to one side of the tool being constantly in contact with cold water, and that a trail of comparatively hot water is in contact with the other side. Of course, this uneven temperature produces strains which often result in fractures whose cause is looked upon as a mystery.

I therefore held the tool stationary while it was immersed and to my satisfaction experienced no further difficulty.

Proposed New Building of the Franklin Institute of Philadelphia

This institution for the promotion and encouragement of manufactures and the mechanic and useful arts is about to erect a magnificent structure on the New Parkway which extends from the city hall to Fairmount park; the contemplated location is at the point where the Parkway intersects Sixteenth and Arch streets. Last year the "Franklin Fund" held in trust by the Board of City Trusts was set aside for the use of the Franklin Institute in erecting a new building, providing a sufficient sum was collected independently of this amount, which could be added to the Franklin fund so that a suitable building could be erected for the use of the Franklin Institute; the same to be a memorial to Benjamin Franklin.

Suggested Design

The suggested design illustrated shows an imposing edifice surmounted by a dome located on a triangular plot of ground. The building will be isolated so that an abundance of light can be secured and, as planned, will include a large auditorium and a small hall on the first floor, besides the offices, laboratories, and exhibition rooms in the basement. The museum and committee rooms will be situated on the second floor and the third floor will be occupied by the schools of the Institute, which include mechanical, free-hand and architectural drawing, machine design and naval architecture. The extensive technical library will occupy the entire fourth floor. The reading room and reference library will be directly under the dome. The stack room will be at either side of the building and space will be provided for smoking and conversation rooms. The building will be so designed that conventions of manufacturers and meetings of scientific bodies can be held in the main auditorium, exhibition hall and committee rooms, without interfering with the ordinary use of the building.

Available Funds

The committee having the building project in hand has subscriptions amounting to over $220,000, which, together with the "Franklin Fund," and the value of the present building, brings the entire amount available at the present time to over $400,000. The committtee has hopes of obtaining additional subscriptions, as a larger sum will be necessary to cover the erection and maintenance of a building which will be an ornament to the city of Philadelphia, as well as a fittting memorial to Benjamin Franklin.

The Franklin Institute was not established by any fund bequeathed by Benjamin Franklin. It was established in 1824, after his death, and named in his honor as a tribute to his usefulness. While the Institute is well known in the city of Philadelphia, and by scientists in general throughout the United States and Europe, very few persons are acquainted with its history.

Founding of the Institute

In the year 1824 the first meeting for organization was held in the county court house at Sixth and Chestnut streets. The meeting was very largely attended and when the election was held the roll contained between 400 and 500 members. The object of the association was "the promotion and encouragement of manufactures and the mechanics and useful arts, by the establishment of popular lectures on the sciences connected with them, by the formation of a cabinet of models and minerals and a library, by offering premiums on all objects deemed worthy of encouragement and examining all new inventions submitted to it and by such other measures as it may deem expedient." From the very first the supreme aim of the Institute was the instruction of mechanics.

The scientific library has grown until at the present time it numbers about 100,000 titles, many of the volumes being very rare, and it is considered one of the most important scientific libraries in the United States, but the space available is inadequate to properly house this extensive library, which is growing, and will continue to grow, not only in size, but in value, every year. Besides the regular course of lectures of the Institute there are certain sections relating to special subjects, such as physics and chemistry, photography, electricity, mining and metallurgy, mechanics and engineering. These sections have their own meetings and discussions of papers relating to their special lines, the members thus keeping abreast with the times. The *Journal* of the Institute is a technical publication having a circulation not only in this country, but throughout many countries of Europe and is found upon the shelves of all scientific and technical institutions abroad.

Technical Work of the Institute

The first exhibition of American manufactures in the United States was held under the auspices of the Franklin Institute in the year 1824 in old Carpenters Hall in Philadelphia, and since that notable event the Institute has held over 29 exhibitions. Many of the exhibitions held by the Institute have proved to be of incalculable value to the city, State and country. The National Electrical Exhibition held by the Institute in 1884 is acknowledged by all who are engaged in electrical industries to have been by far the most important event of its kind ever undertaken. The reports of the board of judges of that exhibition, which was composed of eminent men of science in Europe and America, and the admirably planned and thorough tests of lamps and dynamos and other electrical apparatus, have given to the Institute a standing in scientific circles at home and abroad such as it never before enjoyed.

PROPOSED BUILDING FOR THE FRANKLIN INSTITUTE

Membership

The membership of the Institute is not confined to the city of Philadelphia. The membership is divided into two classes: One, the resident membership, the other, the non-resident membership. The non-resident members will be found in almost

every city of the United States, so that the Franklin Institute, while primarily a Philadelphia institution, is, in fact, a national organization, and if the plans of the present managers are carried out its sphere of usefulness will be greatly enlarged owing to increased facilities, as the new building will be one of the finest and best equipped of its kind in the country, if not in the world.

Inserted-tooth Cutters and a Cutter Grinding Fixture

By Wm. G. Thumm

At page 396, A. York shows a sketch and gives a description of an inserted-tooth cutter. I have been using this style of cutter for about one year, and have overcome the objections he makes to using square steel for the cutters. I am using both round and square, and find the

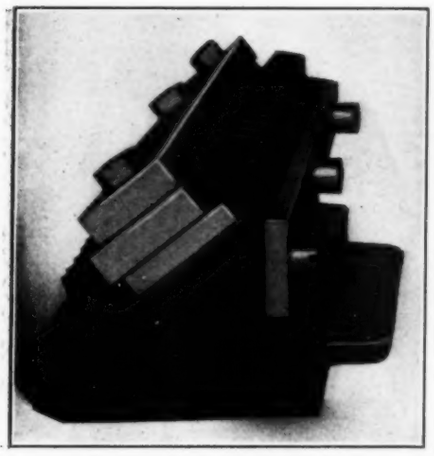


FIG. 6. END VIEW OF GRINDING FIXTURE

square steel to be the most satisfactory. While the square-hole cutter head is more difficult to make, I overcome this by milling the slots in the head and fitting a ring on the outside; although this may not be considered good practice by some mechanics on account of the pressure of the fastening screws forcing the cutters against the ring,, which pressure, owing to the ring being fitted on an angle, might have a tendency to force the ring from the head. I also overcome this by screwing studs in the solid part of the head and between each slot, and rivet the ring to the head. This makes the ring rigid, and it shows no tendency to push away. The square steel is also much easier to make a grinding fixture for, while from the round cutter I never did get any very satisfactory jig results.

Fig. 1 shows a face view of the head with sixteen 5/16-inch cutters of high-speed steel, and the method of holding the cutters with headless set-screws. The steel used is the same as is used in the Armstrong tool holders. Fig. 2 is a rear view of the cutter showing the taper shank and square ends of the cutters which, by the way, can be pushed out without taking the cutter off of the shank.

Fig. 3 shows the grinding fixture with square pockets 1/8 inch deep, and a set of cutters which are held in position with set-screws, and on which the cutting points have been rough ground to the cutting angle; in this fixture they are to

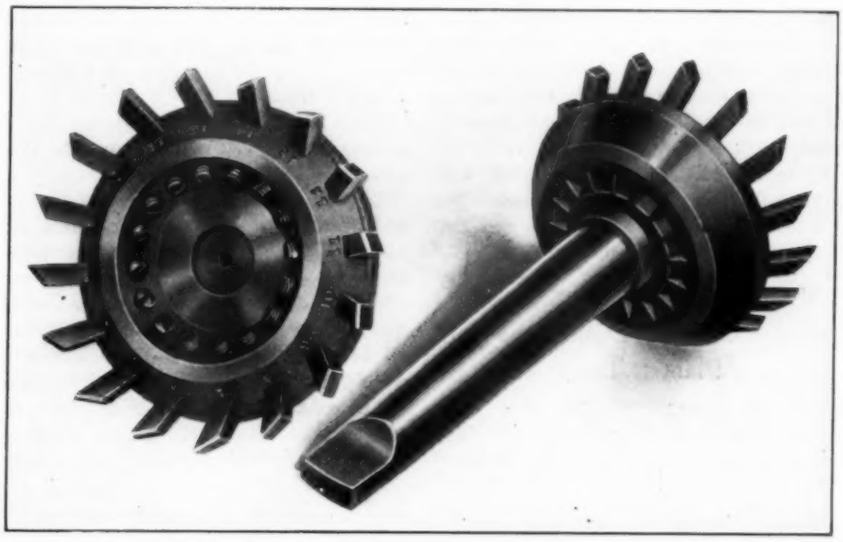


FIG. 2 INSERTED TOOTH MILLING CUTTERS FIG. 1

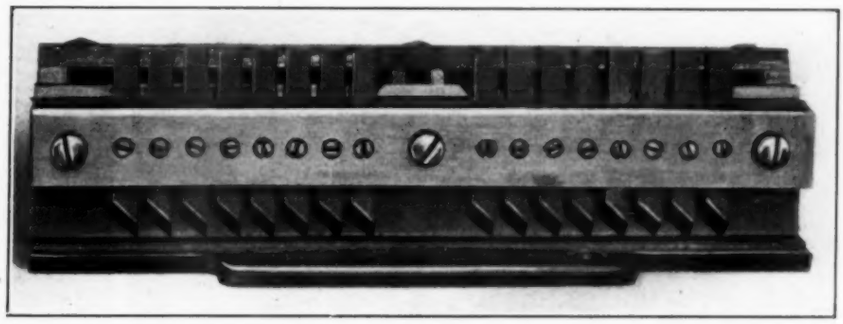


FIG. 3. GRINDING FIXTURE WITH CUTTERS READY TO BE GROUND TO LENGTH

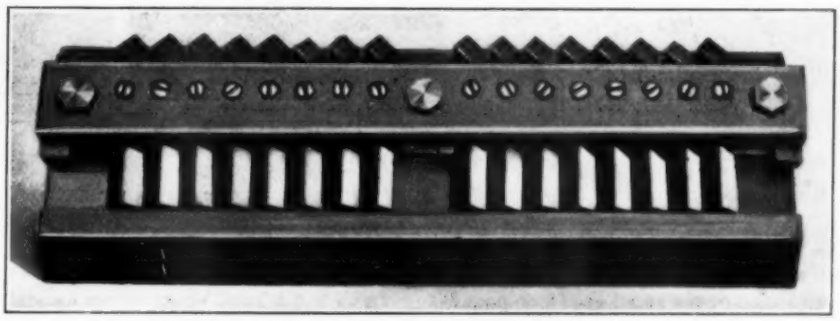


FIG. 4. GRINDING FIXTURE WITH CUTTERS READY FOR GRINDING ON THE FACE

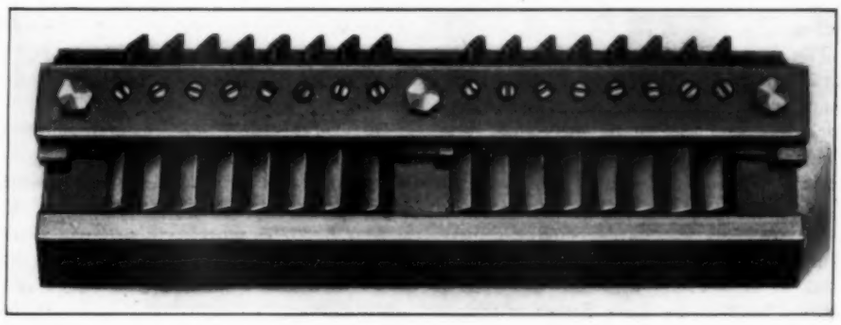


FIG. 5. HOLDING THE CUTTERS FOR GRINDING THE POINTS

be ground to one length, after which they are placed in the opposite side of the fixture, as shown in Fig. 4, which has 90-degree angle grooves ⅛ inch deep in the fixture as well as in the clamp screw-plate, to be ground on the cutting face. Then they are given one-quarter turn in the fixture, as shown in Fig. 5, and the adjacent cutting point is ground. Fig. 6 is an end view of the fixture and shows the vertical as well as the sloping side, the angle of which is 38 degrees.

I use the hardened steel for these cutters, and grind on a surface grinder, but this device can be used with annealed steel on a milling machine as well.

Gears of Unusual Dimensions with Planed Teeth

The illustration shows a cut gear and pinion recently produced by the shops of H. W. Caldwell & Son Co., Chicago, Ill. The gears are of a semi-steel mixture, the weight of the large gear being 13,200 pounds and of the small gear 8100 pounds. The pitch diameter of the large gear is 95.51 inches and of the pinion 55.41 inches. Width of face 27 inches, pitch 3 inches.

The gears were cast in halves and the joints planed. The dimensions of the gears are unusual on account of the small pitch as compared with the wide face. The teeth were machined in a large gear planer, it being considered preferable to plane the teeth, rather than mill them on account of the extraordinary dimensions of the gears. The gears are to be used in connection with the drive of a mining hoist in the Lake Superior copper mines.

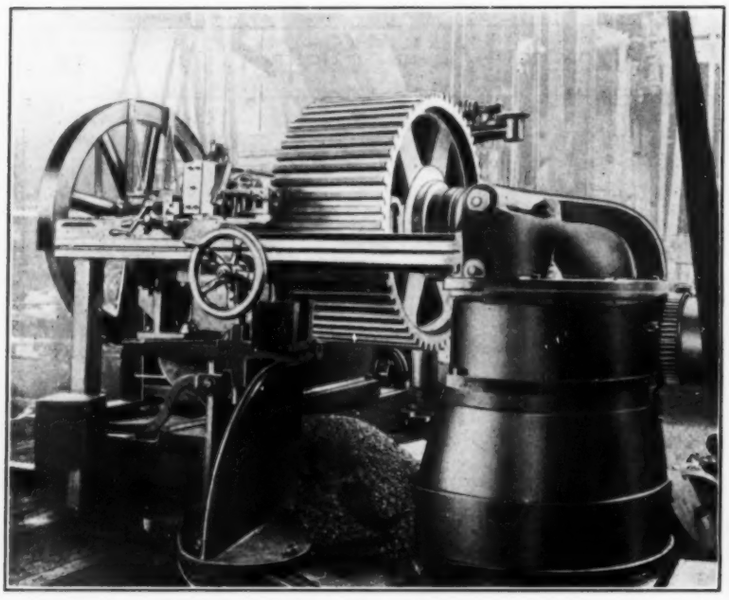


FIG. 1. PLANING A LARGE PINION

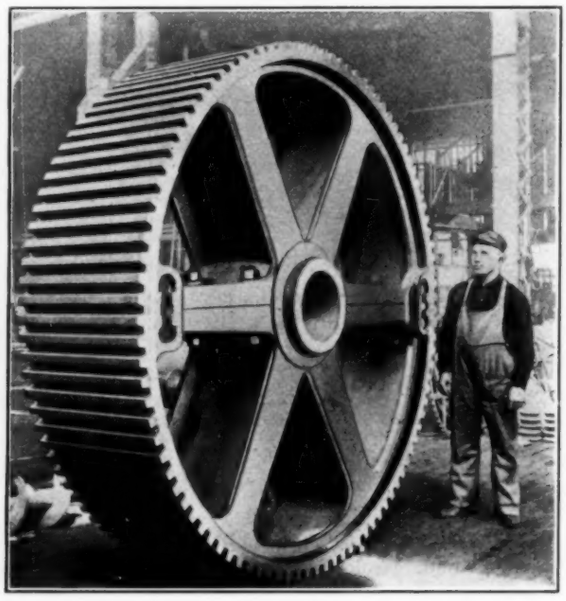


FIG. 2. A LARGE GEAR WITH PLANED TEETH

Helps and Don'ts for All Who Grind

The following extracts from an advance copy of a booklet by the title given, recently issued by the Norton Company, Worcester, Mass., will be found of assistance to many in selecting and using grinding wheels:

Don't believe that all materials can be ground equally well with one and the same wheel.

Spindle speed and character of the material, shape of work to be ground and surface of wheel in contact are prime factors.

In cylindrical grinding, speed of work, diameter of work and depth of cut must all be reckoned with in the selection of the right combination of grain and grade.

The condition of the machine affects the efficiency of the wheel. Heavy machines with large wheel spindles and massive wheel support call for a different wheel than lighter machines with smaller spindles.

Don't use a hard wheel to economize—it is production you are after; big production is economy.

A hard wheel is more apt to change the temperature of the work or to become glazed than a soft one; furthermore, it requires more power to do the same amount of work.

It is a common error, when grinding steel and cast iron, chilled iron and hardened steel, that to produce a fine finish a wheel must be as fine as the surface desired. A coarse wheel will produce a fine finish, if certain facts about grade, depth of cut, speed of work, speed of wheel, etc., are observed.

When grinding brass and the softer bronzes, to obtain a finish the wheel must be as fine as the finish required. Bronzes with "manganese" or "phosphor" admit of coarser wheels.

For a fine finish on hard stock, a coarse wheel may be necessary, and the harder the stock the coarser the wheel.

The width of the wheel should be in proportion to the amount of the material to be removed with each revolution of the work.

If you reduce the width of the wheel, you must use a finer feed, and consequently do less work.

Never mount wheels without flanges.

Flanges should be, at least, one-third the diameter of the wheel; one-half is recommended—always concaved, never straight or convex.

Use pulp or rubber washers a trifle larger than the diameter of the flanges, or flanges with soft-metal facings.

Don't start work on a new wheel until you are sure it runs true.

Never attempt to true a wheel for round grinding unless the diamond is held in a rigid tool post on the table of the machine. You cannot do good work with such a wheel when it is trued "by hand."

Don't start to grind until you know the speed is right—not "near enough," but right.

Even a slight variation in speed may be the cause of success or failure of any wheel.

Failure is sometimes turned into success by merely changing the speed of either the wheel or work.

Complaint is sometimes made that wheels appear to be softer toward the center. Usually this is because the same surface rate of speed is not maintained as the wheel is reduced in diameter. This causes the wheel to wear away faster and

appear softer. It is also true that while the grade of the wheel may be uniform throughout, yet the smaller line of contact due to the smaller diameter will cause the wheel to appear softer.

To increase the speed of a grinding wheel gives the effect of a harder wheel; decreasing the speed gives the effect of a softer wheel.

For surface grinding, it is customary to run wheels at a somewhat slower rate of speed than for general grinding. A speed of 4000 to 5000 surface feet is usually employed. Wheels are run in actual practice from 4000 to 6000 feet per minute.

Transferring a wheel after worn down to a small diameter, from a large machine to a small one, is a good plan.

Don't use the wrong wheel on a job because it will require a few minutes' time to change wheels. A stop watch will prove to you that changing wheels is cheaper.

Considerable difference in diameters of work will affect the cutting quality of a wheel on any given material.

A successful wheel on the smaller diameters may work much slower on the larger.

A wheel most suitable on work of very large diameter may wear away too fast on work of smaller diameter.

A suitable wheel for small diameters may cause chatter on pieces of large diameters.

Don't grind round work dry.

A good wheel will grind in water, soda water, or oil.

Water keeps the wheel working cool and increases grinding production.

Soda water keeps the work and the machine from rusting.

Oil in soda water also increases the wheel's effectiveness.

You are not expected to know everything about grains and grades of wheels. That's the wheel manufacturers' business, and they are glad to help you if you will let them.

Notes on the Design of Fits for Various Designs of Shafts

By E. H. Fish

A point in machine design which has bothered me to make clear to students would perhaps be of interest to men who are working their own way up, although it must be necessarily more easily comprehended by workmen already used to putting work together, than by students whose ideas of shop construction are rather hazy. If a student has a number of gears or pulleys to be put on a shaft and the shaft is to be supported in bearings, he is apt to look at the line shaft in the shop and bring in a sketch of his machine like Fig. 1, with only one dimension given for the size of the shaft and no provision for keys, or set-screws, or means of taking up end play.

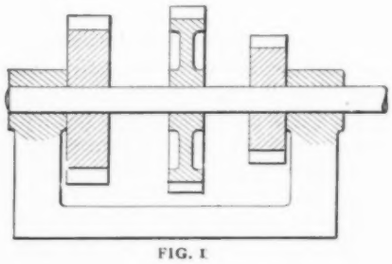


FIG. 1

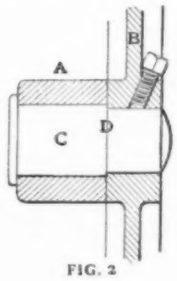


FIG. 2

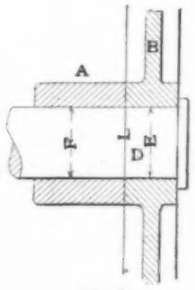


FIG. 3

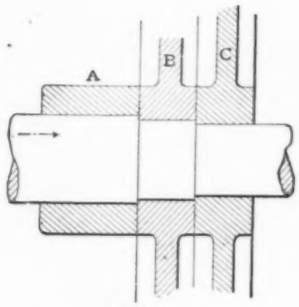


FIG. 4

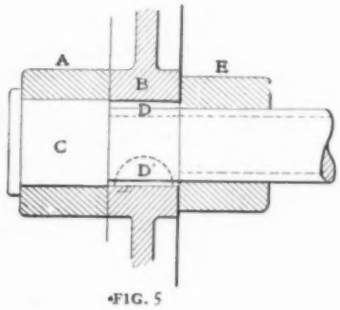


FIG. 5

SKETCHES ILLUSTRATING THE FITS OF SHAFTS

To convince him that his design will not do for machinery where accurate running is necessary I sketch something like Fig. 2; *A* is a bearing and *B* a gear which must be fast to the shaft *C*. This shaft, for some reason or other, must be put in from the left-hand side. Now, if we ream both *A* and *B* with the same size reamer and turn the shaft *C* to go through the bearing *A* it will not be tight enough in *B* to prevent the set-screw from throwing it out of true. If we ream *A* with one size reamer and *B* with a smaller size, say, 1/16 inch less, then we can make the two parts of the shaft a driving fit and a running fit in *B* and *A* respectively and yet assemble the job easily. Moreover we now have a shoulder at *D* to prevent the gear *B* from being driven up too far and binding endwise on the bearing; in other words, we can make the end play what we wish.

If, on the other hand, the parts can be assembled by putting in the shaft from the right-hand end, as in Fig. 3, then both holes can be reamed to the same size and the shaft turned to fit each as desired; the part in *B* can be a few thousandths larger than the part in *A*. In drawing this type I use a fine line at *D* to show the difference in fit. Ordinarily the same dimension should be used at *E* and *F* though in a shop where standard sized holes are maintained the actual diameters required should be expressed to thousandths.

There is a disadvantage in this construction in that the minute shoulder at *D* offers almost no resistance to pushing the shaft too far to the left, and unless there is a fixed collar on the shaft as shown it will be apt to cause trouble. With two or more gears or pulleys, as in Fig. 4, and a shaft which must be put in from the left the best method when feasible is to reduce the diameter to that of the next smaller reamer at each gear. If there is a nest of these gears this may be impractical owing to the great reduction in the size of the shaft. In that case all the gears may be carefully reamed and by the use of a long key running through all of them and some means to prevent the gears from working endwise a satisfactory job may be made.

In either Figs. 2, 3 or 4 keys can be inserted readily in the shaft where the gear fits on, staked in position and then the job assembled without difficulty. If the gear is to be between two fixed bearings, as in Fig. 5, it will be necessary to make the bearing at *A* large enough to allow the shaft *C* with the key *D* (or *D'*) in place to be pushed through easily. That is, hole *A* will have to be larger than hole *B* by twice the amount that the key extends above the surface of the shaft. The hole in *E* may be the same size as the hole in *B* and a running fit may be secured by making the shaft at *E* a few thousandths smaller than it is in *B*. If the square key shown at *D* is used the man who does the keyseating will thank the designer if he has the shaft turned down to the dotted lines so that he can start his planer tool without digging out a starting place by hand. If the Woodruff key, shown at *D'*, is used then the full size of the shaft can be maintained. This expedient and the one shown in Fig. 3 are useful in that they each save turning off stock and preserve the strength and stiffness of the shafts.

All-core Molding of Turbine Rings

Design and Construction of Core Boxes. Rodding, Wiring and Venting of Cores. Sweeping the Mold and Style of Top Used

BY JOSEPH HORNER

The illustrations show the way in which the writer has made several sets of buckets and guides for turbine rings, ranging in diameter from about 5 feet to 8 feet. The work is nearly all cores, hence the principal interest of the job centers in the core boxes, and the way in which the mold is made from them. Portions of the two rings are shown in Figs. 1 and 2, in plan and vertical section, respectively. The three tiers of buckets and guides, Fig. 2, provide the means for working the turbine at full or at reduced gate, and the blades in these tiers are cast in one with the webs which separate them, and with the upper and lower plates. The ring of guides also has a ring cast with it which is bolted to the inlet pipe, and down the inner vertical face of which the governor ring moves when the full inlet is afforded to the water.

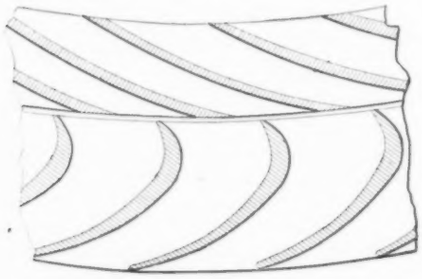


FIG. 1. TURBINE RING PLAN VIEW

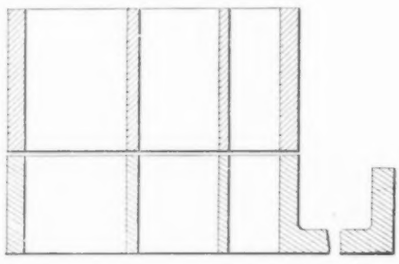


FIG. 2. TURBINE RING SECTIONAL VIEW

It is obviously desirable to include the separating webs and the top and bottom plates in one complete core, including the three tiers of openings, the reasons for which are facilities in making and setting. Sometimes the three tiers of cores are made separately, and set one over the other, but there is then difficulty in getting them plumb. There might also probably be some slight distortion due to sag before drying, in which case they would not be alike. The objection sometimes urged against making them in one is the difficulty of blackening the web openings, which only give about ½-inch or 5/8-inch spaces, but a thin camel-hair brush on a long handle gets over that difficulty. The matter must be settled before the core box is made because it must be made either as a single box for the three tiers, or in three separate boxes, one for each core. But in either case the boxes must be divided where the webs come, for the purpose of rabbeting out the recesses for these.

As each passage is quite separated from its fellow by a web, the actual cores could only be stood on one another by the use of chaplets, which would be a bad practice, and insecure. But by extending each core into a print formation at each end they can be supported thus by the extraneous aid of the prints; see Figs. 3 and 4, illustrating outer and inner rings respectively. Neither will these extensions of the cores require any sweeping of a circular ring or rings to set them by, for they can be set by lines struck on a level bed. Nor is any filling up required between the core extensions if they are made to abut by their edges, and so just complete the circle. This is shown in Figs. 3 and 4, which represent three cores each for the outer and inner rings respectively as they appear when laid together on a leveled sand bed by the circles *A A*, struck on the bed. The print extensions are made to complete the circles extending at *B B*, beyond the terminations of the cores with that object.

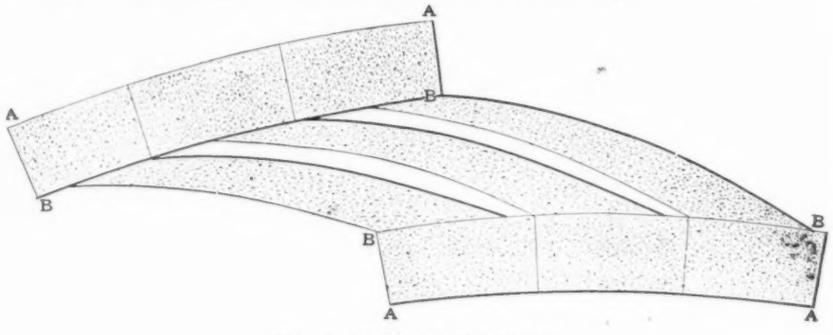


FIG. 4. CORES FOR INNER RING

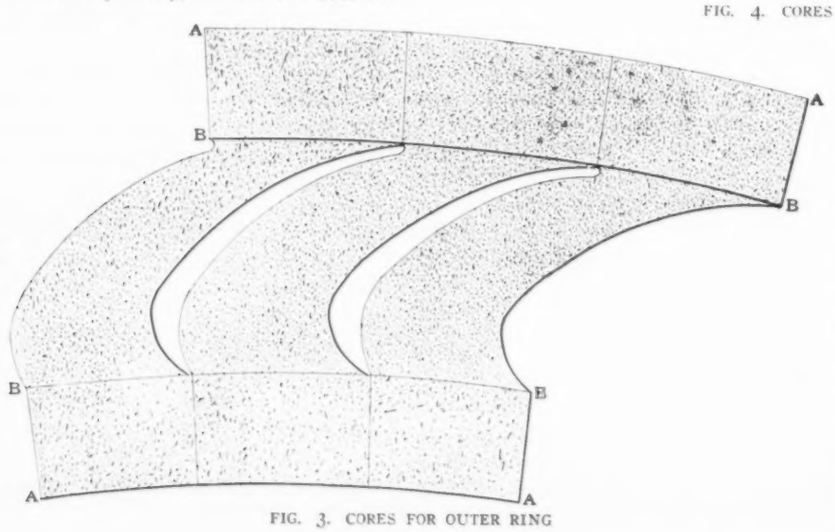


FIG. 3. CORES FOR OUTER RING

Views of the core boxes are given in Figs. 5 and 6. These are drawn from a view of the box in the position in which the cores will lie in the mold, that form the buckets in Figs. 3 and 4. An outside view of the box is shown below. The main body of these boxes is composed of the outer framing *E*, and the inner blocking *F* with hardwood facings. The reason for facing with hardwood is that the large numbers of cores rammed in a single box, when orders are repeated, would soon roughen up and destroy the accuracy of the box if pine were used. The backing *F*, therefore, is made of pine to lessen the cost, and the facings *C* are of hardwood glued and screwed to *F*. The method of blocking up the backing *F* is

adopted in the larger boxes for the purpose, partly of economizing timber, but chiefly to lessen the risk of shrinkage. The same object is sought in arranging the blocking and facings with end grain on, as indicated by the shading. A plank-way arrangement would result in shrinkage in course of time, with a reduction in the depth of the cores made therefrom.

Whether the box sections are to be rammed together, or the cores separated, it is better to make the box first of all to the full depth of the rings, plus about half an inch for sawing into three parts, and planing the sawn faces. This device not only saves time in working through, but insures the three boxes, or box parts, being precisely alike.

The internal shape of the box is best marked from a templet, first on one side then on the other, squaring over from one face to the other as a guide to the templet. The recesses for the shrouding plates *D* and the intermediate webs are rabbeted down into the joint faces of the boxes, as indicated in the lower view in Fig. 5. The pieces for webs and shroudings are prepared to the proper thicknesses and curves, and to fit freely enough to be drawn out of the core box endwise, but with scarcely any side play. They are indicated in place in the box in Figs. 5 and 6, except that the top one is omitted, in order to permit of better showing the blocking in the box.

The boxes can now be used separately for superimposed separate cores, or be fastened together to form one. Or preferably the three-tier core can be made by putting the three box sections over one another as the ramming up proceeds, because this gives the coremaker a better chance to ram every portion to the best advantage, especially the parts that lie below the webs, which can then be struck off for the webs to rest upon. But the box parts must be registered over one another with dowels to prevent side shifting. They can be kept down firmly with weights, or iron staples, or dogs.

The boxes are parted along the joints *H H*, and the frames open at the corners *I I*, where the wooden clamps *J J* hold them temporarily during ramming. A core made to the full depth of the ring is shown in Fig. 7. It is rammed on cast-core bars *L* and wire rods *N*, and a central space is occupied with cinders passed through a ⅜-inch sieve, whence the vents come out at the print ends.

When the ring of bucket cores is laid down on the face of the mold the work is practically completed. The cores are simply adjusted by their print edges to circles drawn on the sand, as already stated. A plain top alone is wanted, and this may be swept up in loam on a ring plate large enough to cover the mold below *O*, Fig. 8. Or a top box can be used equally well, both methods being employed. The metal is poured through from six to eight ingates made in a single circular-pouring basin and drops down into the bucket spaces. Vents are brought away outside the ring of cores.

The guide ring is not quite so simple a mold, because the governor seating is cast with it. The guides are cast lowermost, and the ring is swept up above them. For the outside a plate is loamed over and turned down on a level bed,

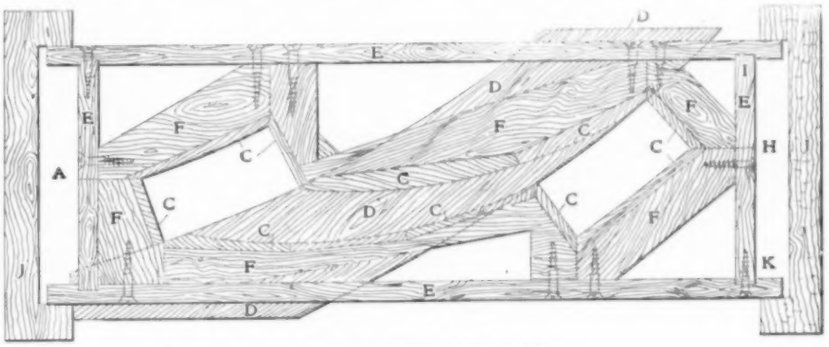


FIG. 6. CORE BOX FOR INNER RING CORES

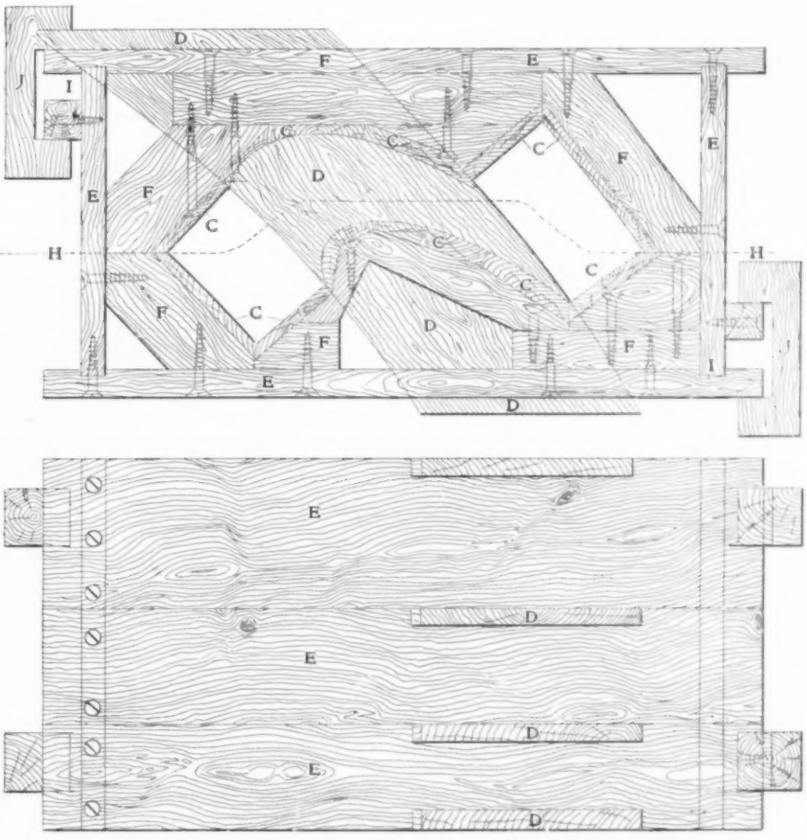


FIG. 5. CORE BOX FOR OUTER RING CORES

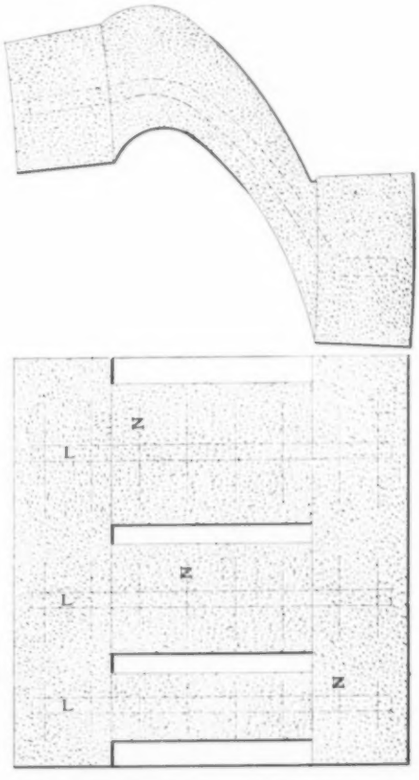


FIG. 7. FULL DEPTH CORES

swept anywhere, then a ring is bricked up on the plate and swept with a board sweep. The ring when dried and finished is lifted bodily, and laid on the ring of cores that form the guides. But before it is finally set the inside must be struck up.

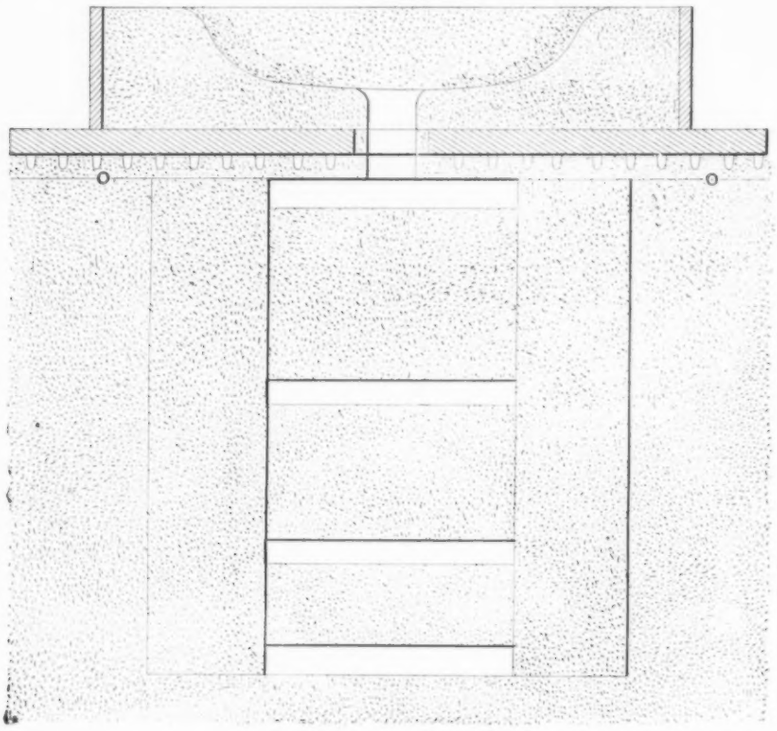


FIG. 8. THE MOLD WITH TOP READY FOR POURING

The inner portion of the governor ring can be swept on a loamed plate similarly to the above or be swept in green sand. If the latter, a number of rods must be rammed in vertically and horizontally to support the sand, and a sweeped piece must be used to form the actual face neatly, because it cannot be swept to a vertical edge like loam. The method of pouring, etc., is similar to that of the outer buckets. The plain loam top may be used, or the top molding box is equally as good when put on, as shown in Fig. 8, the view of the completed mold.

Butter-making by electricity—not by the use of electric power in driving cream separators or churns, but by the direct application of the current to the cream—may be accomplished if a recently patented process proves to be of practical value. It is declared that the effect of the current on the cream is primarily to separate and mass in globule form the butter fats held in solution, adding these, hitherto lost, to the butter fats held in suspension. If this is so, the invention is an important one, for obviously the amount of butter made from a given amount of cream will be increased.—*Western Electrician.*

A Taper Boring Head

By Dynamic

The machining of a taper hole is a job that must be handled with care, no matter by what means it is done, and we run across many jobs that must be machined by means of a bar.

We have two courses, either of which we can follow in the latter case: We can equip our bar with reamers for forming the taper sides to the hole, or we can bore the hole out with a single-pointed cutter, as is used in ordinary boring.

This method of machining the taper hole requires special fixtures. The essential feature of these fixtures is the automatic feed of the cutting point along the required angle, and is generally accomplished by means of a screw, and threaded star wheel which is actuated by means of a pin or pawl.

Fig. 1 shows a boring head constructed on this principle. In this construction the tool block is guided in a dovetail way, and is fed along this way by the screw and star-wheel nut. This head may be fastened to the bar by means of set-screws or by taper pins. The bulk of metal on the opposite side of the head is to counterbalance that on the cutter side.

The most serious objection to the ordinary boring head is that of slowness of operation as the cutter must be returned to the starting point by rotating the star wheel by hand to bring it there. This is a tedious job on account of the fine pitch of the thread used on the screw.

This fault is overcome in the design shown here, as the thread in the star wheel is mutilated in such a way that the wheel may be tipped over on the screw, as shown in Fig. 2 and the screw slid through.

Fig. 3 shows a side view and section through the star wheel showing the mutilated thread. The mutilation is accomplished by means of a rat-tail file. It could, of course, be done by boring through the wheel at the proper angle, but the hole is generally small and the thread being of such fine pitch that with the file one will do the work in the time used in trying to set up the wheel on the face plate at the proper angle. The clearance for the screw thread when the wheel is tipped must extend up past the center of the thread as at *a* in order to clear on the sides. This mutilation leaves but three or four threads on one side of the hole at either end of the wheel, but these will be strong enough, and as the wheel is made of tool steel the wear will not be rapid.

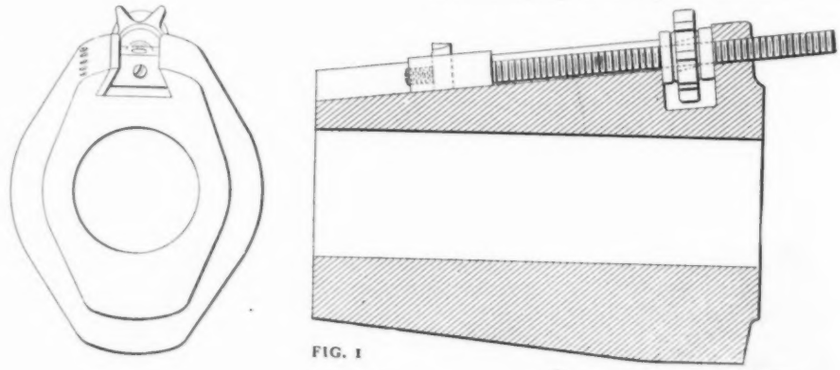


FIG. 1

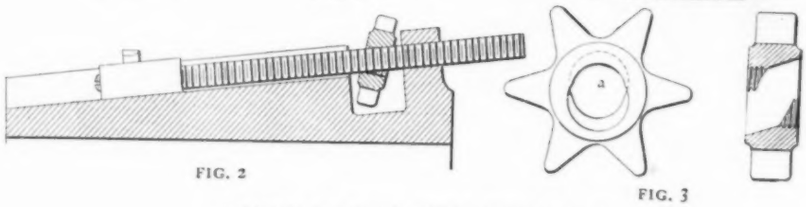


FIG. 2

FIG. 3

A BORING BAR WITH QUICK RETURN FEED

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

A Multiple Perforating Die for Shells

Fig. 1 shows a perforation punch and die, for perforating the four holes in the transmitter shell shown in Fig. 4. A similar device, of course, is adaptable to any similar job.

Fig. 1 is a top view of the die with everything except the shell in place ready to start operations. *a a' a'' a'''* are the four punches which are constantly forced back by the springs *b b' b'' b'''*, and prevented from coming out of their relative blocks by the little back plates which are held in position by the dowel pins shown. The four slots and four holes in the center are intended for scrap clearing.

The cast-iron base block *E* is milled to receive the four punch-holding blocks and keep them rigidly in place fixed by two screws and two steady pins. This way provides an easy and accurate way of fixing.

A side view is given in Fig. 2, showing the several parts in position. Fig. 3 is a sketch of the punch, which simply consists of a steel casting *A* with four cast-steel wedges which are guided while acting on the punches by the slots *F F' F'' F'''* (Fig. 1). The plunger in the middle serves to keep the shell in position and to prevent it from working upward.

When well made this way of perforating is good, and, the tools actually did from 2000 to 2500 pieces before grinding was required. A sketch and section of the shell, which is a sliding fit on the ring *C*, constituting the perforating die, is given in Fig. 4.

Nottingham, England. E. J. W.

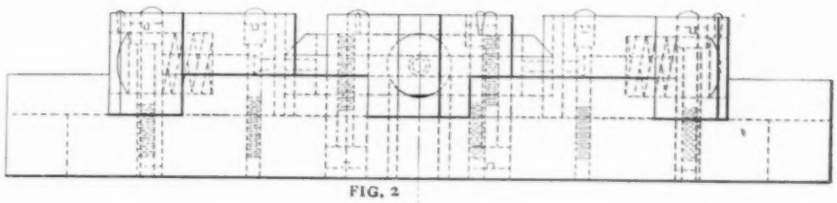


FIG. 2

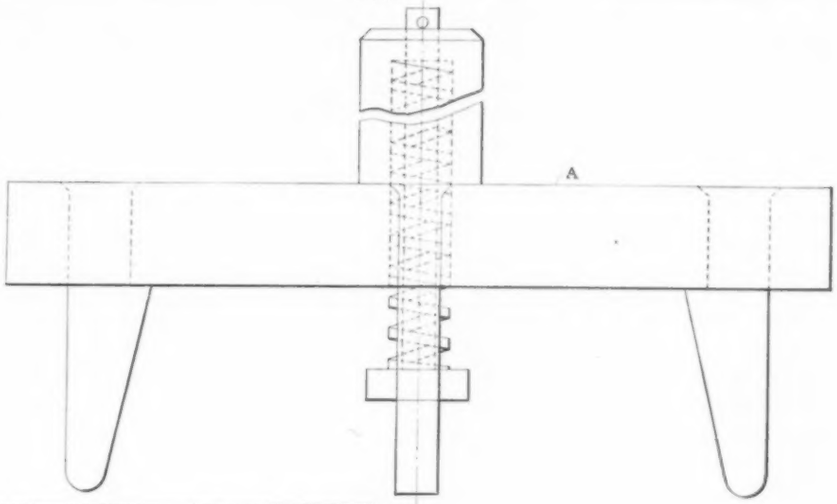


FIG. 3

ELEVATIONS OF THE DIE AND PUNCH

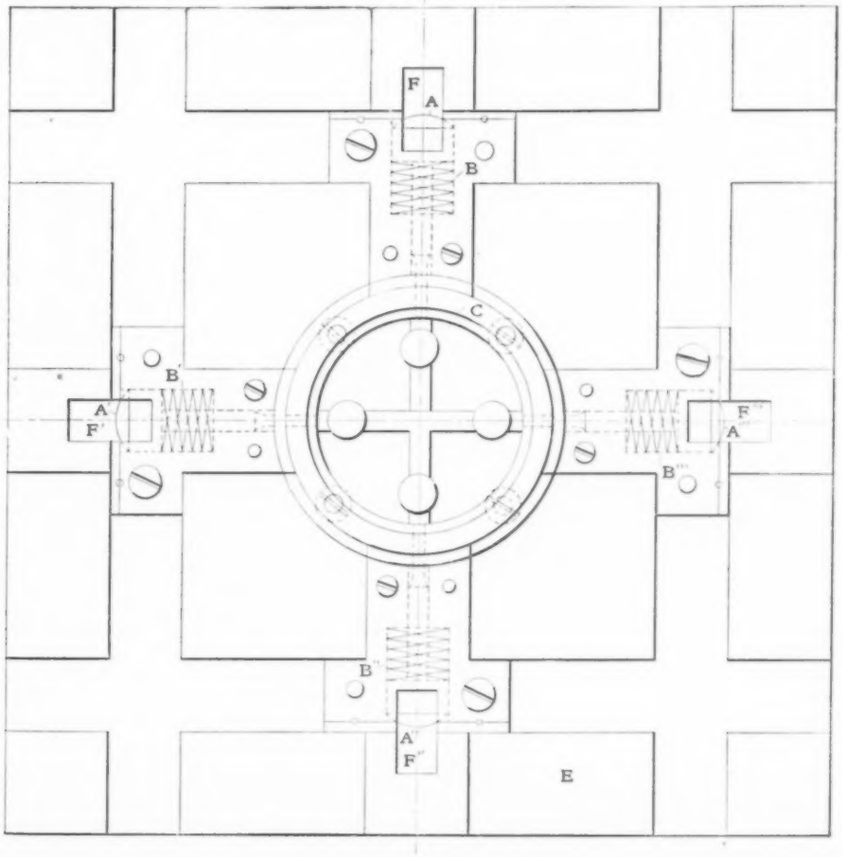


FIG. 1. PLAN OF DIE

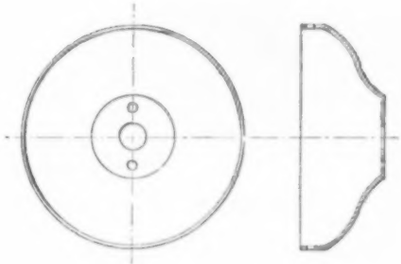
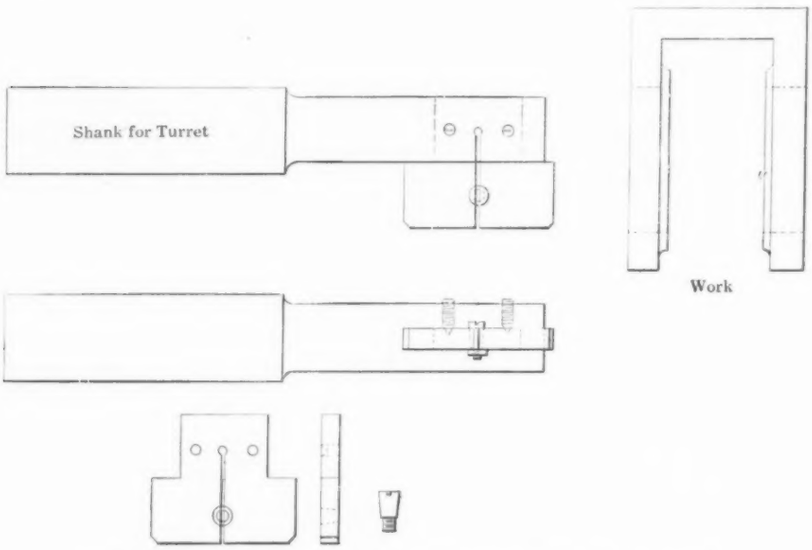


FIG. 4. THE WORK

Expanding Tool for Finishing Inside of Crosshead

The illustration shows a tool for machining inside bosses on crossheads. Having recently had difficulty in keeping



EXPANDING CUTTER FOR FINISHING CROSS-HEAD SHOULDER IN LATHE

cutters up to size I have made this tool for doing the work. It works well and saves time, money and trouble. The old way of doing this was very costly, as when the finish cutter began to wear and cut under we had to send it to the smith shop, have it drawn out, hardened and ground, which means delay. With this tool we take up all wear by the taper pin in the cutter and still have our size without grinding or blacksmith work. The cutter is held in place by two 60-degree pointed set-screws, the cutter being countersunk to receive them.

RALPH W. TOLMAN.

Jamaica Plain, Mass.

The Indian's Canoe

This story belongs to Bill, but he won't care. We had been working for several days on a new design which was to be a "world beater." The engineer in charge and his leading draftsmen had laid out some good schemes, but several people, including the sales manager and purchasing agent had actively interested themselves in the matter. Inasmuch as their criticism took the form of adding finish, or making it better, the cheap part of the specification rapidly vanished. As more people mixed in, the worse the design looked, and would work. In despair the engineer opened up his heart to Bill, an engineer of many years' experience, both with machines and men. Bill advised that he tell the chief engineer the Indian story without giving any application.

The Indian story worked so well that it is given here in the interest of certain suffering humanity.

An Indian was building a canoe along the conventional design of his race. A friendly and officious trapper stopped to admire it and advised a higher bow. This suggestion met with favor and was adopted. A second white man advised greater beam; a third suggested a shallow keel. Several more made suggestions which seemed to better the design. After an interval the first trapper happened by again and noticed that the Indian was building another canoe. He stopped to advise again. "Building another, John," he said, "don't forget the high bow." The Indian grunted in reply, "Huh! Go to blazes. This Indian's canoe."

Wilkinsburg, Penn. F. W. HARRIS.

A Neat Punch Job

This shows a punch-press fixture for making copper pins, as shown at Fig. 4. The slots *a a* are at an angle of 10 degrees, the ends parallel with slots. In operation the copper in coils is inserted in die at *a*, Fig. 1, the arm *b* acting on rollers *c c* forces block *d* forward and clamps work solid, while the punches *e e*, Fig. 3, cut the grooves and the shear *f* cuts the piece off. The springs *o o* draw back block *d*.

The work is gaged by *g*, which is operated by stud *h*, so timed that the gage is lifted from the work before the cutting off takes place, to avoid a tendency to bend the pin by being forced against the gage by the action of the shear.

While there is nothing particularly novel about the tool, it strikes me as pretty good practice for the average shop. It enabled us to get them out in much faster time than ever before and only tied up the punch press.

The pins are used in large quantities in electrical work, and were formerly made by cutting off in punch press and milling slots in fixture. The difference in cost of production is apparent, the output being limited only by the speed of the press.

Toledo, O. A. HANTON.

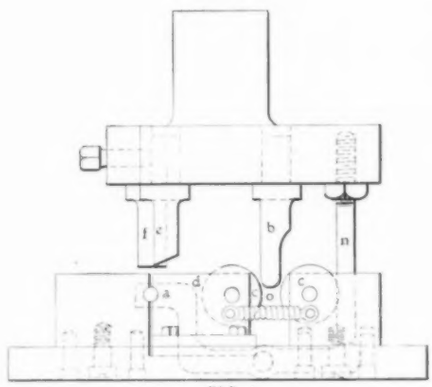


FIG. 1

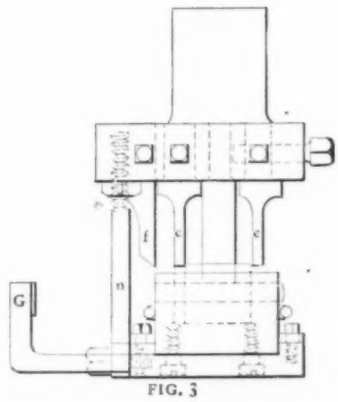


FIG. 3

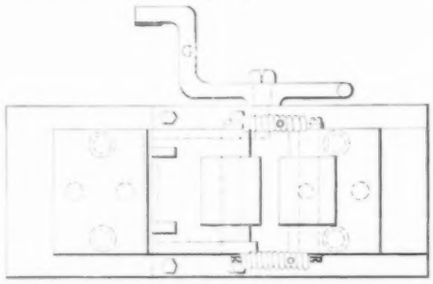


FIG. 2

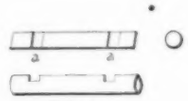


FIG. 4

A NEAT PUNCHING JOB AND THE TOOLS FOR DOING IT

A Crooked Slotting Job

Three views of a cast-iron water pipe of rather twisted shape are shown at Fig. 1. The problem to be solved is the machining of a quantity of these pipes to an exact angle and length. Our first method was to set them up on the slotting-machine table with the overhanging flange supported by means of packing underneath. The first attempt at machining the flanges produced pipes which, when bolted to place, were right neither as to angle nor length. The difficulty was overcome in the following way:

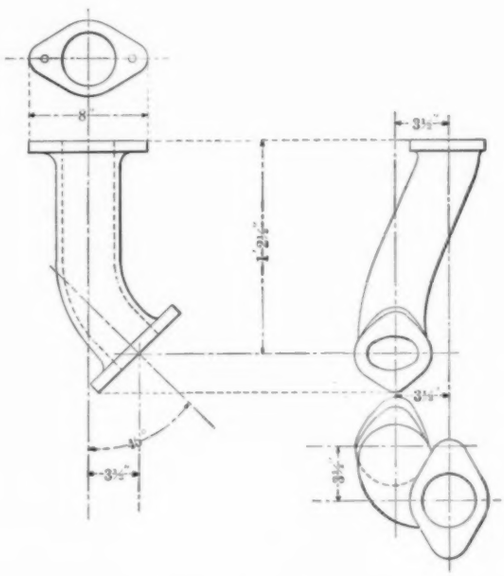


FIG. 1

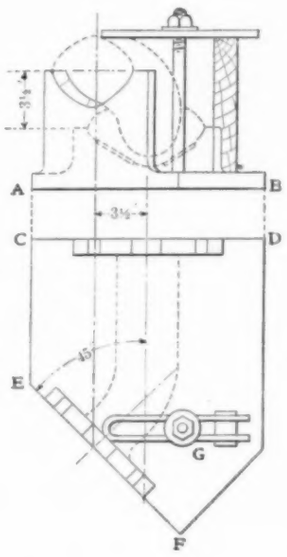


FIG. 2

FACING THE ENDS OF A CROOKED PIPE

At Fig. 2 are shown two views of a cast-iron fixture suitable for bolting to the slotting-machine table, and machined on the following faces: *A B*, *C D*, and *E F*. The faces *C D* and *E F* are machined to the finished dimensions of pipe, also the exact angle. When the fixture is bolted to the table it is set, so that by sliding the table from *C* to *D* or *E* to *F* the point of the cutting tool will be perfectly parallel for the entire length. The pipe is held fast to the fixture, as shown at *G*. Before the pipe is machined it, of course, projects over the faces *C D* and *E F*. The dotted lines show the position of the pipe when bolted down ready for machining.

The operations of machining are: Set face *C D* parallel to the cutting tool and machine flange until the tool just touches the face *C D*, then turn the table round, set face *E F* parallel and machine the other flange. It will be observed that the flanges do not "bed" down in the cradle of the fixture their entire length, but on three strips only. The rough flanges thus set better being supported only at a few points. This method of machining saved any worry or uncertainty as to the accuracy of dimensions.

Glasgow, Scotland. J. BLAIKIE.

Pattern for Lathe Cabinet Leg

The sketches shown illustrate the building and molding of a lathe cabinet leg. There are so many of these made that it is worth while to study out the easiest way of molding them.

We first tried with a parted pattern but this left so much grinding and cleaning to do, and bad metal on the cope side of the machined part *E*. We next tried molding it on end and had a great deal of trouble with lugs *H*, Fig. 2, until adding the dovetail *D*.

Figs. 1, 2 and 3 show the pattern with core prints, loose prints and dovetail, also the thickness of metal. The cutout for the door is in the main core; the openings *A* are cored separate; the pieces *E* are doweled to the pattern and parted through *X* to help draw them from the mold, the lugs *H* are fastened on a hardwood dovetail *D* as shown in detail in Figs. 1 and 4. Fig. 4 shows the way the pattern is built; ¼-inch holes are drilled through the corner as shown at *R* to securely fasten the hardwood bottom pieces *S* by gluing in a dowel.

In molding, sand is rammed up to the parting line, Fig. 1, the flask rolled over and the cope rammed up. After this lift away the cope, rap the pattern at the rapping plate *P* and draw the pattern out; then draw the lugs *H* in the mold and out. Pieces *E* should be taken out the same way and the mold slicked up, making it ready for the cores.

The main core should be set in core print *B*, then drop in the small cores *A*, put on the cope and clamp it down.

This may seem a simple pattern to illustrate, but we had a lot of trouble before being able to get good, clean castings and would be glad to hear if anybody has a better way.

Cincinnati, Ohio. A. C. JONES.

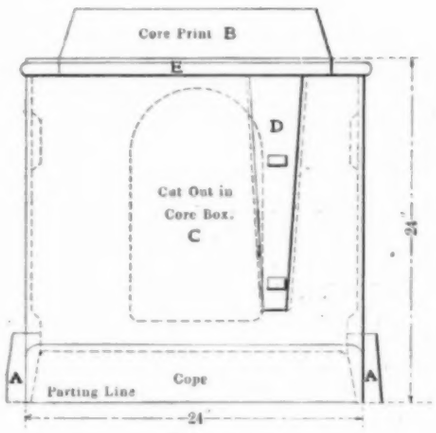


FIG. 1

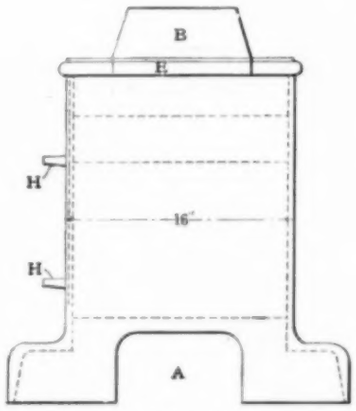


FIG. 2

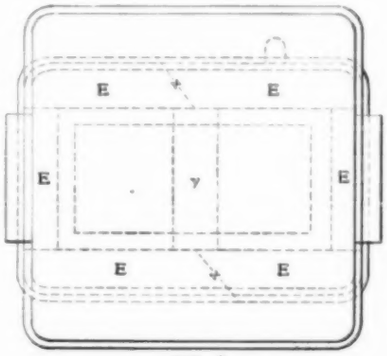


FIG. 3

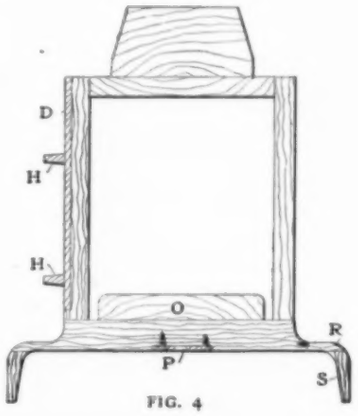
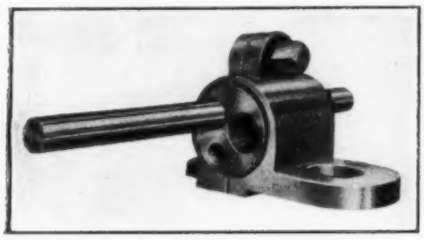


FIG. 4

LATHE CABINET LEG PATTERN FOR MOLDING ON END

Holder for Round Boring Tools

The illustration shows a boring-tool holder for three sizes of round boring bars using high-speed steel inserted cutters. I designed this tool some years ago and while the one shown has been in use only four years, I have used the same method for holding round bars for



HOLDER FOR ROUND BORING BARS

more than twenty years and have never known them to slip if tightened with ordinary care.

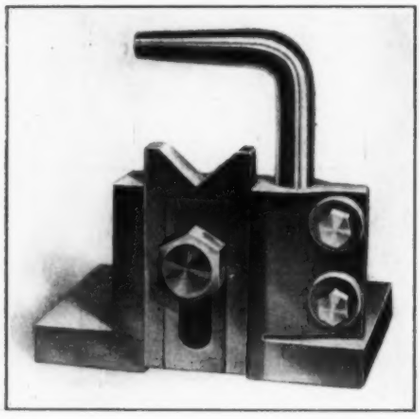
The body fastens to the tool block with the tool post which goes through the large hole and clamps it fast when a tool is inserted. The split bushing can be turned to bring the tool to the desired hight and is clamped by the screw at the top.

It will be noted that the bushing is split from the outside in to the large hole and from this to each of the smaller holes. In this way the one screw clamps the bar no matter which hole it is in.

Concord, N. H. W. H. KING.

A Milling Machine Steady Rest

We have a steady rest which we use for a good many jobs on the milling machine.



A MILLING MACHINE STEADY REST

The cut shows the way it is built, the body being of cast iron, the lower jaw or sliding V is of tool steel hardened and ground, the overhanging arm is also of tool steel hardened and ground, and it was made taper to give it strength and at the same time to make it as low as possible in order to get under arbors or cutter collars.

A key in the bottom fitting the slot in milling-machine table centers the device.

A milling-machine hand doing toolroom milling, will at once see the advantages of this steady rest for many special jobs.

Decatur, Ill. ETHAN VIALL.

An Adjustable Grinding Fixture

Figs. 1, 2 and 3 represent a grinding fixture used on Brown & Sharpe No. 2 surface grinder for grinding turret-lock bolts.

The idea of this fixture is to enable us to grind surface *P* at right angles with surface *Q* shown in Fig. 2. The first operation is to grind surface *Q*, then by placing surface *Q* against surface *N* you are ready to grind surface *P*. Should lock bolt *L* show out of square after being perfectly ground on surfaces *P* and *Q*, the adjusting plate *A* can easily be raised or lowered by means of adjustment screw *J*, tightening binder screw *K* after each adjustment. After you have a fixture adjusted so as to have your work come perfectly square, or at right angles, you are then ready to go ahead and grind any number of pieces desired.

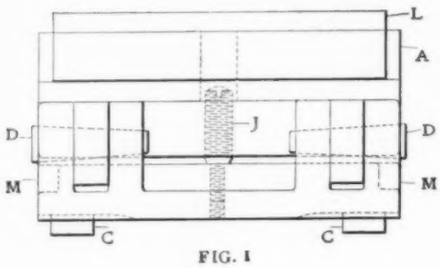


FIG. 1

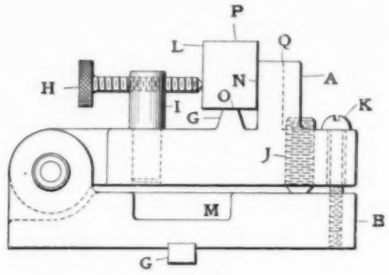


FIG. 2

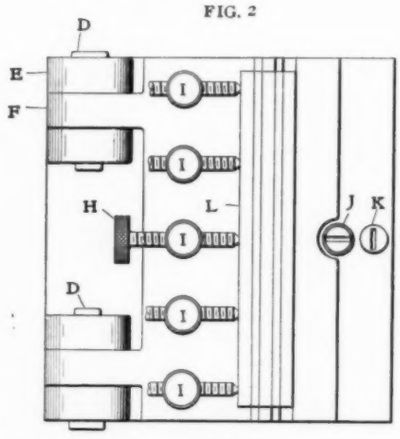


FIG. 3

FIXTURE FOR GRINDING TURRET-LOCK BOLTS

The fixture is provided with five clamp screws *H*, as shown in Figs. 2 and 3, but I have not found it necessary to use more than three on this particular piece of work, as it takes very little tension with screw *H* on lock bolt *L* to make it safe from moving while grinding. Clamp post *I* is made a loose fit and can be swiveled around in any position.

Anyone who has had any experience in surface grinding knows it is a very difficult matter to take a chuck or fixture off the machine, put it back, and have it cut same as before. To overcome that point the fixture is provided with grinding strips *C*. These strips if necessary, can be trued off as often as necessary to obtain parallel work. If after constant usage either strip *C* should become too low, it will be a small matter to screw on new strip.

This fixture is located on the center of the table by tongues *G* as shown in Figs. 1 and 2, and is held down on the table by means of two small clamps, same as used to hold the vise that comes with Brown & Sharpe machine. These clamps rest on surface *M*, as shown in Fig. 2. Base plate *B* and adjusting plate *A* are both made of cast iron and hinged together by means of taper pins *D*. Hinge *F*, as shown in Fig. 2, is made to work a shade easier on taper pin *D* than it does in ear *E*, so as to allow the taper pin *D* to be driven tight into ear *E*, and still have a working fit in hinge *F*.

There is something that I have not given a very great test so far, but from what experience I have already had with it, I am quite sure that it will cut the time less than half on this particular job. It does not matter how much your grinder may cut high or low at either end or edge of work, it will easily be overcome by the adjustment, which has been already explained.

In grinding lock bolt *L*, it is not the intention to grind more than the two sides *P* and *Q*, as after you have obtained a perfect right angle, it will be an easier and more profitable way to put a number of lock bolts *L* on the magnetic chuck and finish the other two surfaces.

Franklin, Penn. B. M. WELLER.

A Pair of Straddle Mills

Fig. 1 shows a pair of straddle mills made in a way that I have never before seen employed for this job.

The disks are cast iron, about a foot in diameter. The cutters are of high-speed steel. No screws, taper pins nor extra fastenings of any sort are used to secure the cutters in the disks.

After being cut to size, the blanks for the cutters are annealed. They are then milled flat on one side, cocked up at one corner and a gradually diminishing cut is taken across the other face from corner to corner. The shape of the cutter is shown in the line cut, Fig. 2, at *B*. The cutters are then tempered and ground, although grinding is hardly necessary.

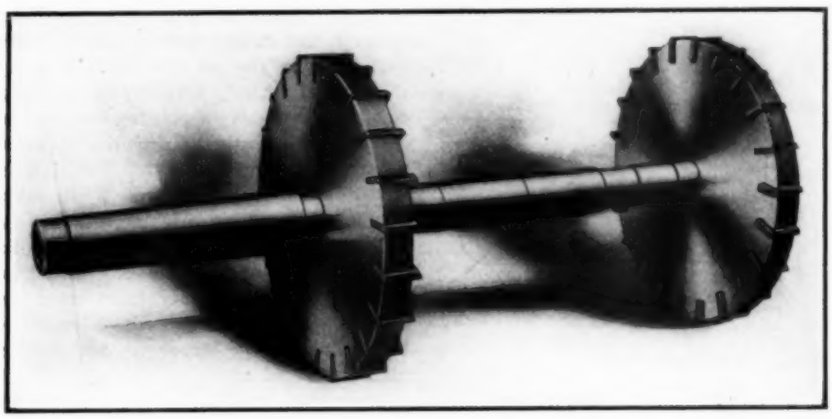


FIG. 1. A PAIR OF STRADDLE MILLS

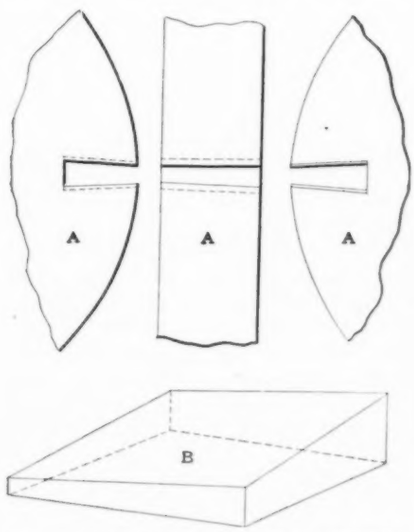


FIG. 2. THE SLOT IN THE DISK AND THE CUTTER

The disks are slotted in the milling machine, as shown in Fig. 2 at *A*, two cuts being necessary owing to the wedge shape of the cutters. After the disks are slotted, the cutters are driven in solid and the teeth of the assembled cutter ground on the cutting edges. The teeth cannot come loose, but are easily driven out when it is necessary to replace them.

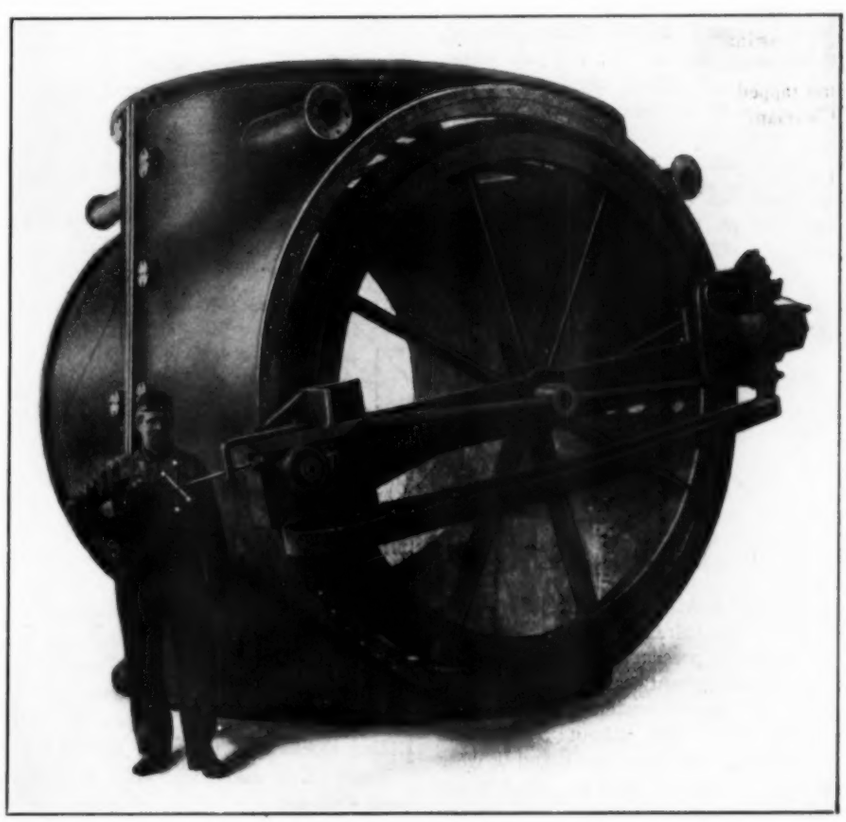
I ran across this pair of cutters in the shops of Lipe & Walrath, in Syracuse. It was designed by W. C. Lipe.

E. A. DIXIE.

A Portable Milling Device

There is shown in the half-tone a 10-foot cross made by the Straight Line Engine Company, which was too large to ship by cars, if in one piece, and too large even when parted to be machined by any machine owned by the company, so the portable machine, shown in the front of the picture, was devised. The vertical spindle-milling head driven by the motor was used on parallel ways to dress the straight joints, and then pivoted on the spider, except that it was on top, rather than on the side, as shown, to dress the circular faces. A temporary screw about 4 feet long was used to put on the feed. The accuracy of the work depended on the accuracy of the ways for the straight joint, and the circular faces on the accuracy of the face of the spider. Neither the cost of the rig nor the work was excessive. The weight of the cross was only about 13 tons, so the size and frailty were a matter of more concern than the weight. The electric drive renders such jobs particularly practicable, that is, the taking of the machine to the work, rather than the work to the machine.

Syracuse, N. Y. JOHN E. SWEET.



A PORTABLE MILLING DEVICE ON A LARGE JOB

Catalog Indexes

You have always advocated a standard size for catalogs, which has been a good thing; but is not the way catalogs are indexed a nuisance? Some are indexed in the front, some in the back and others in the center. When you are looking for a certain thing you are sure to turn to the wrong place. I find the best thing as a time saver is to cut off the corners of the pages that have the index. I cut the top corner of all my catalogs in this way and can find the index the instant I open one of them. I think if you would advocate a standard way of indexing catalogs it would be advocating a good thing and a time saver.

South Bend, Ind. JOHN B. HABERLE.

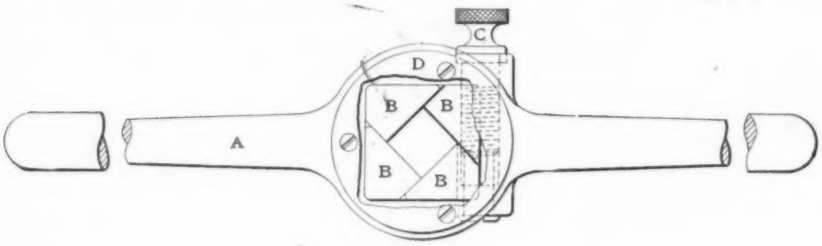
Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

An Expanding Square Hole

On page 845 there is illustrated a model showing how a square hole having perfectly square corners can be reduced in size without changing the shape. The writer of the article suggested that some fellow may come along and use it as a tap wrench. I am inclosing a little sketch of this arrangement which I applied to tap wrenches at the Pratt & Whitney Company's work in the year 1877. The two wrenches that we made were in use in 1881 to my personal knowledge, and were is as perfect condition after constant use as when given out for trial.

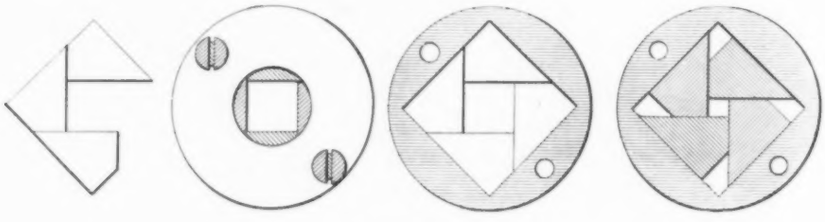


TAP WRENCH WITH EXPANDING SQUARE HOLE

A is the stock. *B*, the sliding jaws. *C*, the adjusting screw. *D*, the cap plates which are used on both sides, the screws being tapped in the opposite plate.

Cleveland, Ohio. JOHN J. GRANT.

On page 845 E. A. Dixie gives us an illustration of an expanding square hole model. As far as its use for a tap wrench is concerned I wish to inform Mr. Dixie that it has been already used for that purpose. I am at present unable to give the date, but such patent was issued to an inventor of some western State about eighteen months ago. About 30 years ago my brother (since deceased) and I were working out some experiments, and he hit on the idea of the effect produced by triangular faces sliding on each other in a confined space. I am sorry that I cannot find the drawing he made of a tap wrench, but show herewith drawings of his, showing its application to a chuck. He made a chuck body and sliding jaws but it was never finished. While the triangular blocks in Mr. Dixie's sketch and the blocks shown by me are a little different, the main principle is the same.



ANOTHER EXPANDING HOLE

It would be a very good recreation for some of the young Techs to take up this matter and study out designs of other sliding blocks than those for square holes.

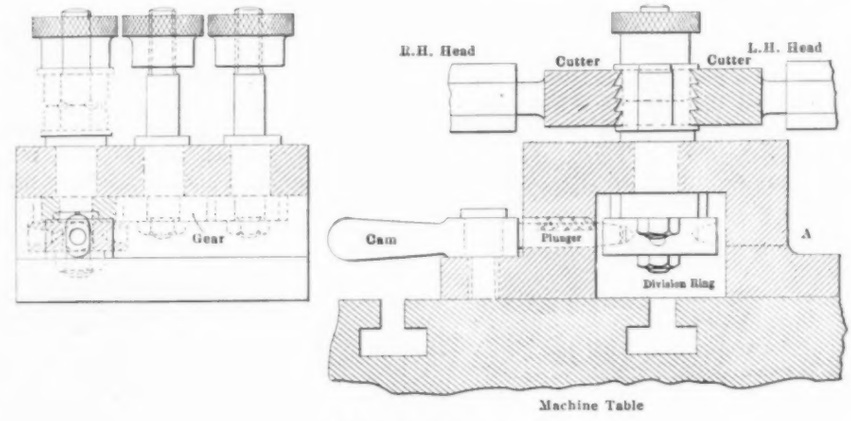
Three-, five- and seven-sided holes have been designed but the sketches are not at hand.

Troy, N. Y. M. J. K.

Milling Hex-nuts

F. C. P.'s article at page 728, and that of J. C. Hafner at page 731 describing hexagon nut milling fixtures, recall a device used in one of the Black country shops of England, which will, I think, compare favorably in points of cheapness and quickness with the majority of brass nut milling fixtures in use. The fixture, as made, is to be used on a standard double-brass milling machine, i.e., a light milling machine with two horizontal spindles opposite each other, having a table operated by either hand lever or screw, but no power feeds—a machine that is used very largely in the district above referred to.

The fixture could, of course, be used on a single-head machine, but there would be a loss of time attendant on its use, under such circumstances. The nuts, before reaching the milling stage, are bored, tapped and faced top and bottom; they are cast hexagonal, and very little stock is left for machining, as the cost of the brass is one of the most important factors in this particular class of work.



MILLING HEX NUTS

As to the fixture it consists of a main casting of channel shape, which is bored to receive three work-holding plugs. Each of these plugs carries two of the nuts to be milled. The lower nut is placed with the flange down, and the upper one is reversed. The top part of these studs is threaded and has two opposing quadrants of the thread cut away. The locking nuts have similar recesses slotted in their threads so that the nut may be dropped over the screw and a turn of a few degrees only is required to lock it. Beneath the shoulders which form the locating surfaces for the work,

the studs are a running fit in the main casting; below this, a gear driven on each serves to turn all the studs at once. On the stud nearest the operator is a division plate containing three dividing holes into which a tapered locating plunger is forced by the action of the cam at its outer end. The plunger is returned by a spring which is guided half in the main casting and half in the plunger.

The action of the fixture is easily seen, the nut is removed, two of the pieces to be milled are slipped over the stud, lined up by the operator's touch and locked in position. The same with the two remaining studs. With the plunger in the first hole, the work is fed toward the cutters by the hand-lever feed. When the three studs have passed the cutters, the cam releases the plunger, the division plate is turned through 120 degrees, relocked, and the work returns, cutting, of course, on the back stroke another set of faces.

A second indexing is then made with the same forward and return feeds and the work is finished. The fixture is very simple to make and to operate and is not likely to easily get out of order. It will be noted that the spring is entirely concealed and cannot be reached by dirt, chips, etc.

Although the line cut shows standard end mills in the cutter spindles, such are not generally used, the average brass founder prefers a double, and in some cases a single-wing fly cutter, for the reasons that it is easier to make and grind and will keep the edge just as long as the ordinary end mill.

Cincinnati, O. A. J. Baker.

Why the Clutch Pins Re-engage

On page 881 Mr. Harfmann shows a die holder and wishes to know why the clutch pins re-engage after releasing. As the die holder appears in sketch it is of the type which is now obsolete, having solid pins. The action of that type of holder is as follows: The die is started on and the turret is fed by hand to follow it. When the turret reaches its stop the die holder begins to pull off the pins until it reaches the ends of the pins and then slips by and revolves with the work, but owing to the strain of cutting the thread it does not slip by easily and the pins hammer slightly against each other as they pass. At the reversal of the work this slight hammering action of the pins is enough to keep the holder from revolving freely backward and it thus catches on the pins after a half revolution or so and the die then starts to back off.

If it were a holder for cutting, say, a 9/16 standard thread, to be used for small work ¼ inch in diameter or so, the weight of the holder would be enough to keep it from reversing when the spindle did and thus make the pins catch.

Lowell, Mass. Paul W. Abbott.

The Construction of Graphical Charts

I am much interested in the article by John B. Peddle, at page 753, on the construction of graphical charts. While I have not had time to go over it in detail, I believe that the general principle involved is the use of the logarithmic charts for formulas that involve anything greater than the unit power of the varia-

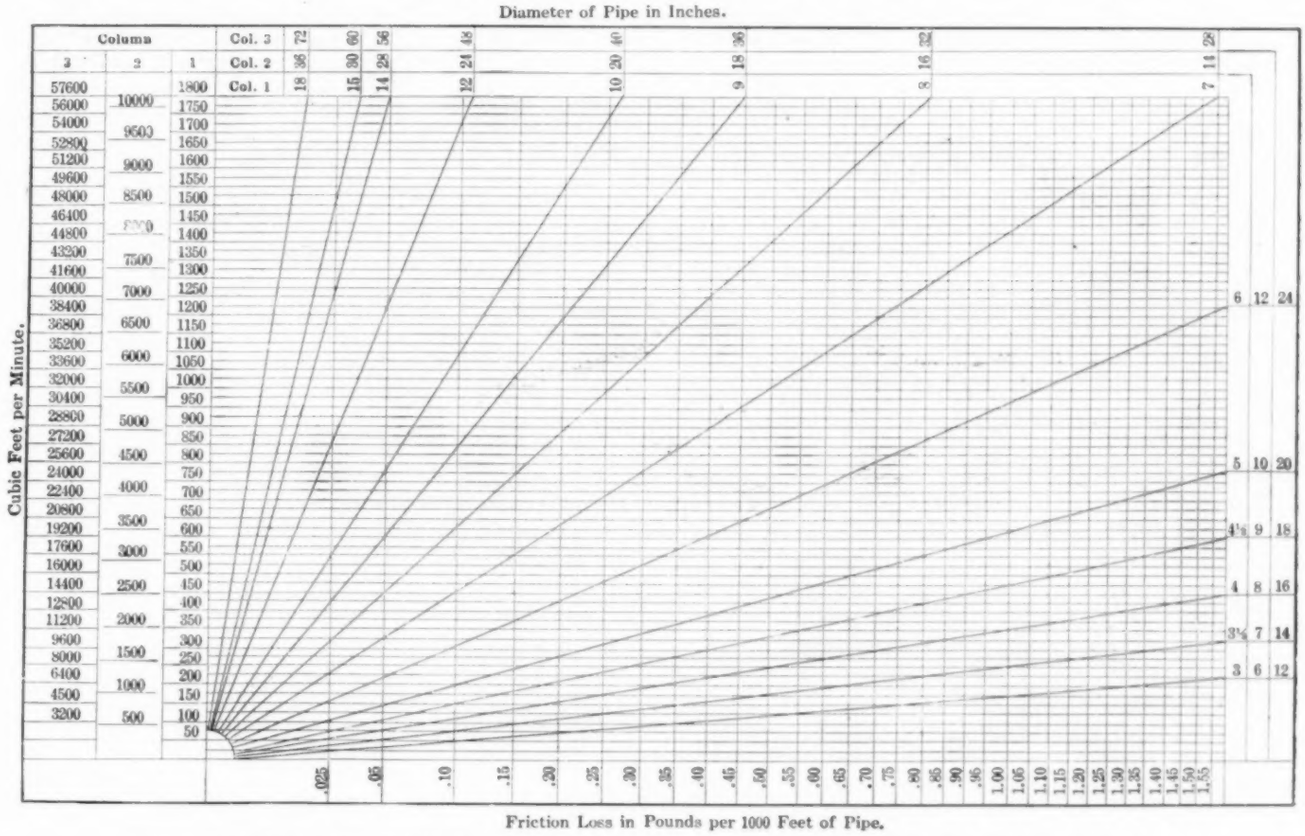


FIG. I. RELATIONS BETWEEN THE QUANTITY OF GAS FLOWING PER MINUTE THROUGH THE VARIOUS SIZES OF PIPE AND THE FRICTION LOSS PER 1000 FEET OF PIPE

ble. In this connection I submit one table, consisting of two parts, which I have worked out for our work. This table covers quite a variety of formulas, several of which involve powers higher than the first. The method, while quite complicated at first, becomes quite simple in use.

The method used is to reduce the formula to such a form that there are only two variables, usually taking the principal factor to represent the diagonal lines. The other quantities are then reduced to such factors that they represent the quantity $Y = M X$, the value of X often being a factor containing squares or the difference of squares, as in the case of the formula for flow of gas. The formula is then solved for each individual line wanted, there being only one solution necessary to establish each line. After these lines are

completed, the proper results are obtained by the solution of the quantity assumed as the factor X. You will, therefore, see that the laying out of these tables is very simple, and that in getting the value of X it is merely necessary to substitute the various values as wanted and then mark them on the bottom of the sheet, laying them off according to the value of the whole factor from which the lines were originally obtained. The accompanying solution will probably make this clear, and I think many will find that this method will be useful.

Friction Loss for Long Pipes

Formula,

$$q = 44.72\, d^{\frac{5}{2}} \sqrt{\frac{P_1^2 - 14.7^2}{s\, l}}.$$

Where q = Cubic feet per minute,
d = Diameter of pipe in inches,
P = Absolute initial pressure,
l = Length in feet, and
s = Specific gravity, air being 1.

The chart, Fig. 1, gives the loss for 1000 feet of gas at 5/10 specific gravity, and cannot be used alone, except for gas at 5/10 specific gravity and a pipe 1000 feet long.

To use the chart, Fig. 2, after finding loss for 1000 feet, look for total length of pipe in feet, project to loss line, horizontally and then vertically, for the total loss.

For air, double the length of pipe before reading the chart, Fig. 2. For any other specific gravity, multiply the length by twice the specific gravity and then use the chart, Fig. 2, first using chart, Fig. 1, in the usual way.

If the terminal pressure is not 14.7, or atmospheric, find the number of lineal feet on Fig. 2 corresponding to the terminal pressure above the atmosphere, add this to the lineal feet of pipe to be used, and read to the loss line obtained from Fig. 1, in usual manner.

Construction of the Charts

In the equation

$$q = 44.72\, d^{\frac{5}{2}} \sqrt{\frac{P_1^2 - P_2^2}{s\, l}},$$

where q = Cubic feet per minute,
d = Diameter of pipe in inches,
P = Absolute initial pressure,
l = Length in feet, and
s = Specific gravity referred to air,

make $l = 1000$,
$s = 0.5$, and
$P_2 = 14.7$.

Then we have

$$q = 2\, d^{\frac{5}{2}} \sqrt{P_1^2 - 14.7^2},$$

letting the diagonal line represent $d^{\frac{5}{2}}$, while q and

$$\sqrt{P_1^2 - 14.7^2}$$

are the variables. This is in the form $y = m\,x$ where $y = q$, $m = (2\, d^{\frac{5}{2}})$, and is a constant for any one line, and $x =$

$$\sqrt{P_1^2 - 14.7^2}.$$

Letting vertical spaces represent cubic feet and horizontal spaces

$$\sqrt{P_1^2 - 14.7^2}$$

on any system of units that will keep the chart within the required limits, we find the value of

$$\sqrt{P_1^2 - 14.7^2}$$

for any size pipe chosen and any value of q. It is best to make q as large as possible, so that the point obtained will be as far from origin as possible. After all the pipe sizes are represented by lines, additional values may be secured by doubling sizes on a single line and adding additional columns in the ratio of $2^{\frac{5}{2}}$, or 5.657; that is, column 2 is 5.657 times column 1 in value; column 3, 5.657 times column 2 and 32 times, or the square of 5.657, times column 1.

Now, to mark the horizontal value, we have only to substitute the value in the factor

$$\sqrt{P_1^2 - 14.7^2}$$

and find the value of the whole factor. This point is found on the horizontal scale and marked with the value of

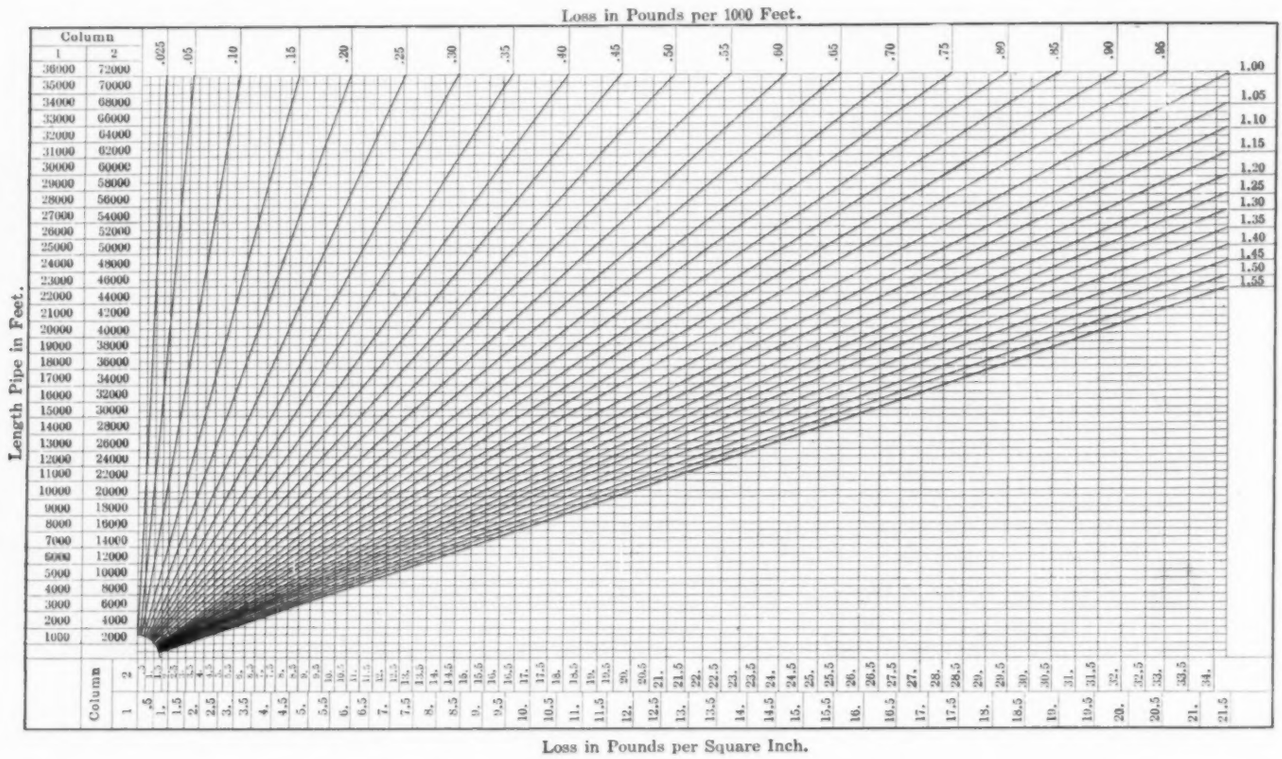


FIG. 2. RELATION BETWEEN THE TOTAL LOSS IN PRESSURE IN POUNDS PER SQUARE INCH OF VARIOUS QUANTITIES OF GAS FLOWING THROUGH PIPES AND THE LOSS IN POUNDS PER 1000 FEET OF PIPE

$$\sqrt{P_1^2 - 14\,7}$$

substituted. Thus, if we want the position of 0.1 loss make $P_1^2 = 14.8$ and solve. We have a value 1.71 which is found in the horizontal line at bottom and marked 0.1.

Anyone will readily see the amount of labor saved in laying out a diagram by this method. It is simple when one has solved it, but it took me some time to arrive at this final solution of a wide range table in compact form.

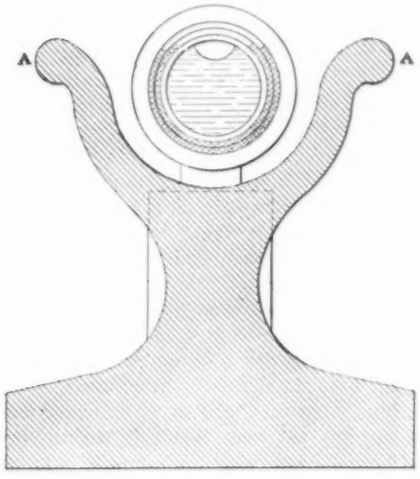
Chart, Fig. 2, takes care of value of greater than 1000 ft. The horizontal values are in the relation of the square root of the lineal distances.

GEO. C. HICKS, JR.

Connersville, Ind.

The Precision Level Twenty Years Ago

The editorial at page 696, on "The Precision Level" says, "We have much to learn from Germany." If the use of the precision level is only just beginning to be appreciated, as stated in this editorial, we



SECTION OF PRECISION LEVEL

can learn something from the columns of the back numbers of the AMERICAN MACHINIST.

On page 6, of the issue of April 28, 1888, is an article on "Accurate Levels," by "Jarno," my pen name at that time. The levels illustrated in this article were copied from several levels made by Bement, Miles & Co., for use in their works. On page 3, issue of July 14, 1888, an editorial on "Some Points About Levels" says that Jarno's cut and description awakened some interest in the subject of good levels. This editorial is readable and instructive. A fine level is shown on page 7, October 6, of the same year.

From the foregoing it would appear that the usefulness of precision levels was fairly well appreciated in America, twenty years ago. At about the same time, Brown & Sharpe made them for export, as well as for use in their own works, where these levels have proved of great help in the production of accurate work.

Experience has shown that great care should be exercised to avoid touching a vial with the hand or fingers, as a little heat distorts the vial and renders it unfit for use: the bubble seeks the heated place, and for a time the tool is no longer a level.

It is also well not to take hold of the vial case in lifting the level. To avoid lifting the level by the vial case, Brown & Sharpe have cast two handle-webs or wings to the body of the level, one web on each side of the vial, as illustrated at *A A*, in the sketch. These two webs form a convenient handle so that the vial case need never be touched. These handle webs are more especially applicable to a level that has the vial entirely above the body.

I have found it convenient to remember that one second of arc is equal to one ten-thousandth of an inch in twenty-one inches radius. Thus, if a level twenty-one inches long is raised a ten-thousandth of an inch higher at one end than at the other end, it will have an inclination of one second of arc. At page 669, C. L. Libby speaks of a four-second level: I like this expression for accuracy because it conveys at once just what he means when he speaks of a level as an instrument of precision. Ground levels, "very sensitive" are advertised, but what we want to know is the number of seconds that are indicated when the bubble has moved the distance between two lines of the vial.

A four-second level can be used to straighten the ways of a planer with considerable accuracy. It is also a pretty good test of a straight-edge. If a level shows a piece to be level at one point, we have only to move the level to another part in order to detect curvature either upward or downward.

The vial of a four-second level costs about fifteen dollars, without the air chamber for varying the length of the bubble. Some workmen prefer a vial without the air chamber because with a chamber, the length of the bubble is liable to change while carrying the level from one part of the work to another part.

After using a precision level one's belief in the stability of things may not be very strong. If one walks in the vicinity of a level, the bubble may move an inch or more. I should not be surprised if a level would indicate the strokes of an engine in a distant part of the building.

Providence, R. I. OSCAR J. BEALE.

[All of which we acknowledge as gracefully as possible under the embarrassing circumstances to be one on us.—ED.]

Nut Lock

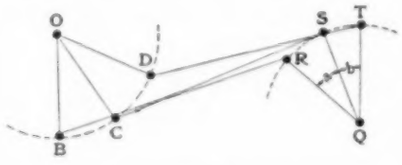
The nut lock shown at page 854 does not seem to be constructed in the most advantageous manner. With the six holes in the flats of the nut, and three slots at 60 degrees with each other in the end of the bolt, the locking positions will vary by one-sixth of a turn of the nut. But if there were only two slots at right angles with each other, then the locking positions would vary by one-twelfth of a turn. This would double the number of locking positions, and also decrease the cost of making the slots. However, the three slots would be all right if used in conjunction with a square nut with four pin holes in the flats.

WALTER GRIBBEN.

Another Geometrical Problem

A problem suggested by the writer two years ago was solved very completely by several individuals, whose solutions were published in Vol. 29, page 414. In working on a Corliss valve gear recently a similar problem arose, which may have interest for some of your readers.

In the figure *O* and *Q* are centers of two fixed axes, whose positions are given. An arm is attached to axis *O* of known



A GEOMETRIC PROBLEM

radius, and its three positions, *O B*, *O C*, *O D*, are given. A similar arm of unknown radius is attached to axis *Q* and is driven by a link *B R* of unknown length. Arm *Q R* is required to turn through angle *a* while the other arm moves from *O B* to *O C*, and then is required to turn through a second angle *b* while the other arm moves from *O C* to *O D*. The positions of the arm *Q R*, *Q S*, *Q T*, are not given, but only the angles between them.

Required to find the length of link *B R* and the radius *Q R* which will give the desired angular motion to the driven arm, by exact geometrical construction.

New Haven, Conn. E. H. LOCKWOOD.

A submarine vessel has recently been built in France for sponge-fishing, according to the *Engineering Record*, which is said to have proved successful in trial manœuvers. It has a cylindrical steel shell about 16 feet long by 5 feet in diameter, and with rounded ends. This shell is not equipped with propelling machinery, but is manipulated from a tender and only fitted with submarine lamps and sponge grapples.

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Contents

PAGE

A Noteworthy Combination Machine Tool 37
Direction of Rotation of Epicyclic Gears 39
Hardening Thin Pieces of Steel..... 42
Interesting Tools and Appliances at the Hendey Machine Company..... 43
Some Special Tools Used in Italian Shop 44
Removing Hardening Scale from High-speed Steel..... 45
Proposed New Building of the Franklin Institute 46
Inserted-tooth Cutters and a Cutter Grinding Fixture..... 47
Gears of Unusual Dimensions..... 48
Helps and Don'ts for all Who Grind..... 48
Notes on the Design of Fits for Various Designs of Shafts..... 49
All-core Molding of Turbine Rings..... 50
A Taper Boring Head..... 52
Practical Letters From Our Readers: A Multiple Perforating Die....Expanding Tool....Neat Punch Job ....Crooked Slotting Job....Holder for Boring Tools....Adjustable Grinding Fixture....Pair of Straddle Mills....Portable Milling Device..53-57
Discussion of Previous Question: Expanding Square Hole....Milling Hex Ends....Construction of Graphical Charts....Precision Level.... Geometrical Problem.....58-61
Purchasing Coal..... 62
New Tools and Machine-shop Appliances 64

Purchase Coal on the Heat Unit Value Basis.

As coal is one of the most important raw materials among the purchases of the average manufacturing plant, it is little short of a truism to say that an intelligent method of purchase, which puts coal upon a fairer basis of return for money spent than is afforded by the usual specification, is of interest and profit to factory managers and purchasing agents. The greater part of the coal used by factories today is purchased at so much per ton under the name of the mine or district from which it is to come, as (using familiar Eastern terms) Georges Creek, New River, Clearfield and the like. There is usually no guarantee, aside from the integrity of the dealer, that the coal actually delivered is from the mine or district specified by name in the contract. But a guarantee as to the district or mine from which a given shipment is to come is no guarantee of its quality; different carloads of coal from the same mine many differ widely in composition.

It is doubtful if any other raw material purchased by factories in large quantities is bought on such a loose basis and without a clean-cut specification of what is to be delivered. It would be folly for a manager to order so many tons of steel made by such-and-such a mill, or so many carloads of pig iron from such-and-such a furnace, or so many pounds of composition castings from a given foundry, or any other important commodity merely by giving the quantity wanted and the name and without a specification as to quality; but, when coal is ordered by quantity and the name of the mine only, is not the position of the manager equally absurd? Coal is one of our greatest and universally known commodities, and were it not for the fact that it is generally bought and sold under such loose conditions we would be in an inexcusable position for taking space to point out a self-evident fact: Coal should be bought on a basis of the results which it will give; that is, on the basis of thermal units.

We all know that coal is made up of a mixture of combustibles, moisture and earthy matter or other impurities that will not burn. When we realize that the quantity of the impurities that will not burn often ranges in commercial coals from 4 to 25 per cent. of the total, there should be brought forcibly to our attention the lack of wisdom in the policy of buying coals without knowing their composition or heat values. The losses from burning a coal too high in its percentage of ash is two-fold: First, the loss in the money paid for material that will not burn and, second, the loss in the efficiency and capacity of the steam-generating plant while handling an excess of ash.

Again, sulphur may be present in the coal in such a quantity as to interfere with its successful burning for a given set of conditions of boiler setting, grate, draft, etc. Very often an excess of sulphur will produce a hard clinker which shuts out air from the furnace, renders firing difficult and tends to rapidly destroy the furnace brickwork. Fortunately the system of purchasing coal on a standard specification of British thermal units and excess of ash is growing; such specifications usually have a clause whereby a bonus and penalty are fixed, in case the coal is better than or does not equal the standard. This feature protects both seller and purchaser.

The Interborough Rapid Transit Company of New York is purchasing about 30,000 tons of coal a month under specifications of this character. Premiums or deductions are based on a rate of 1 cent per ton for variations of 50 British thermal units per pound of coal; the range of 14,101 to 14,150, both inclusive, is taken as the standard for the number of British thermal units per pound. A coal which runs from 12,101 to 12,150 British thermal units, both inclusive, would be subject to a deduction of 40 cents per ton from the standard price; similarly, a coal which runs from 15,101 to 15,150, both inclusive, would receive a premium of 20 cents per ton above the standard price. Deductions are made for volatile matter on a basis of dry coal. A few of the items are as follows: If over 20 per cent. and under 21 per cent. 2 cents per ton; if over 22.5 per cent. and under 23 per cent. 12 cents per ton; if 24 per cent. or over 18 cents per ton. The complete table is made out for differences of one-half per cent. and the deductions are at the rate of 4 cents for each 1 per cent. of volatile matter. Deductions for ash are tabulated for each difference of one-half of 1 per cent. and at the rate of 4 cents for each 1 per cent. increase in ash. Three of the items from this table are: If the per cent. of ash is over 9 per cent. and under 9.5 per cent. the deduction is 2 cents per ton; if it is over 11.5 per cent. and under 12 per cent. the deduction is 12 cents per ton; if it is 13.5 per cent. and over the deduction is 23 cents per ton. Similarly, deductions are made for sulphur according to a table which is made out for each difference of one-quarter of 1 per cent. and at a diminishing rate.

At the present time all of the coal purchased by the Isthmian Canal Commission is upon a basis of heat value which fixes 14,600 British thermal units per pound as a standard for the coal as delivered at Norfolk and Newport News. A sample from each carload, which goes into the cargoes made up at these two ports, is taken by a permanently stationed inspector and sent to the technologic branch of the United States Geological Survey at Washington for inspection. Four hundred thousand tons are to be delivered to the Commission under these specifications during this year.

The Treasury Department of the United States has been purchasing coal

on a heat-value basis for eight years past, and the results thus obtained have caused the preparation of a standard specification which has been used for the department's principal purchases of coal throughout the past two fiscal years. This coal was used in public buildings throughout the country.

A similar set of specifications have been used throughout the past year by the War Department for purchasing coal for arsenal use. During the past fiscal year three contractors have furnished coal to the Frankford Arsenal under these specifications. It is interesting to note some of the results from this procedure. One contract specified as its standard 14,100 British thermal units per pound of coal, 8 per cent. of ash and a price of $2.89 per ton. Out of 27 carloads furnished under this specification only 10 reached or exceeded in quality the specified number of heat units; the maximum value among the 10 was 14,314 and the minimum 14,105. Of the other 17 carloads one ran as low in quality as 12,581 heat units. Of the 27 carloads 21 contained more than the specified amount of ash, although in only 14 cases was the amount sufficient to cause a deduction in the price. While the price specified was $2.89 per ton the net price, after the necessary premiums and deductions were made, ranged from $2.93 as a maximum to $2.26 as a minimum. It is interesting to note that the carload which was paid for at the lowest price averaged 12,681 British thermal units and 17.3 per cent. of ash. Another contract specified 14,500 British thermal units, 6 per cent. of ash and $2.85 per ton as the standard. Of 13 carloads which were furnished under this contract not one reached the standard in either British thermal units, or price and in every case the per cent. of ash was greater than the standard. The coal, however, ran very uniform. The maximum number of British thermal units was 13,860, the minimum 13,426; the maximum amount of ash was 11.35 per cent., the minimum 8.49 per cent.; the maximum net price was $2.71, the minimum $2.52 per ton. A third contract had as its standard 13,700 British thermal units, 6 per cent. of ash and $2.75 per ton. Three carloads were furnished under this specification. The first contained 14,774 British thermal units, 4.49 per cent. ash and the net price per ton was $2.97. The second averaged 14,450 British thermal units, 6.77 per cent. of ash and was paid for at a net price of $2.90 per ton. The third averaged 14,626 British thermal units, 4.56 per cent. ash and received a net price of $2.95 per ton. It is evident that this last kind of coal was underrated by the seller.

Factory managers should appreciate that here is a way to save money: Get value received for the cost of coal by adapting a method of purchase on the heat-value basis.

New Publications

THE METALLURGY OF IRON AND STEEL. By Bradley Stoughton, B. S., Ph. B. 500 6x9 pages; profusely illustrated. Published by the Hill Publishing Company, New York City. Price, $3.

This book covers every phase of the making of iron and steel from the ores into that product which the machinist and builder use in constructing their different apparatus. In its preparation two objects were kept in view and these were to make of it a book that could be used as a textbook in the college and as a guide and reference book to the makers and molders of iron and steel. These two objects have been accomplished in a much better way than in any book which has heretofore been written.

In the conversion of the ores into iron and steel it treats of the different kinds of ores that are used and analyzes their chemical composition, but the chemistry of these is treated in such a manner that it can be easily understood by those not versed in chemistry by a reading of the last chapter, which makes the chemistry and physics used in the book easy to understand. The furnaces used in the conversion of the ore into iron and the iron into steel are gone into in detail and the chemical composition of the fuels, gases and linings are given with their effects on the finished metal.

In describing the furnaces used and analyzing the product, the blast furnace, bessemer converter, acid and open-hearth furnaces and the crucible furnaces are fully described, with the quality and quantity of metal that is turned out by each. The electric furnace, which is being used successfully, is also dealt with in a chapter by itself near the end of the book, but this is clearly misplaced, as it should follow the other furnaces used in making steel.

The causes of pipes, blow holes, etc., in the ingots is very well explained, as well as the mechanical treatments of forging, rolling, wire drawing, etc. The methods of making the molds and cores; the sands and materials used; and the apparatus for melting and pouring the metal for the making of castings is very thoroughly described.

The solution theory of iron and steel and the constitution of steel, iron and malleable iron are well handled. These are illustrated with many charts, photomicrographs, and tables.

The heat-treatment of steel is dealt with in a condensed manner which is not doing justice to the subject, as it is a very important one to the users of steel and students in metallurgy should be given all the details in this part of the subject. The alloy sheets are also treated in a more condensed form than the subject would warrant, owing to the many alloys which are being used at the present time and the many new uses which are being found for them. Some errors occur in a few of the formulas given and a few other errors are met with in the book, but no technical book has yet been written which did not contain some errors, and those which occur in this one are not important ones, and are probably as few as in any book of a similar nature and size which has yet been published.

Apparently too much credit has been given to individuals with whom Professor Stoughton is associated for their discoveries and labors in this field, although this is a natural error owing to their having done a large amount of work along this line. A notable example of this is the crediting of Professor Howe with the first use of the words cementite and ferrite, when the words cement, cementation, ferrous and ferric have been in use for more than a century and the others are merely the result of a natural growth or the evolution of the language, with a large element of doubt as to whether it was some student or a full-fledged metallurgist that first adopted this form of the words.

On the whole, the book is one of the best which has been produced in the English language on metallurgy for the practical steelmaker and worker as well as the student.

Personal *

F. H. Brown has recently become sales manager of McDowell, Stocker & Co., Chicago, Ill.

Geo. P. Bain has been made general manager of the Uwanta Wrench Company, Meadville, Penn.

Otto W. Schaum, president of the Fay Machine Tool Company, Philadelphia, Penn., is at present in Europe on a three months' business trip in the interest of the company.

Fahle Hammar, manager of the Grönkvist Drill Chuck Company, and foster father of the Johannson gages, 20 Morris street, Jersey City, sailed for Europe June 25 on a two months' visit to Sweden.

George W. Heald, for the past three and one-half years mechanical engineer and chief draftsman for the Bates Machine Company, Joliet, Ill., has opened an office as consulting and constructing mechanical engineer in the Old Colony Building, Chicago, Ill.

Wilfred L. Spence, consulting engineer, of Glasgow, Scotland, and Philip D. Ionides, Scotland, manager of the British Westinghouse Electric Company, announce that they have completed arrangements whereby they will enter into partnership in the autumn and carry on a general consulting practice in Glasgow under the firm name of Spence & Ionides.

*Items for this column are solicited.

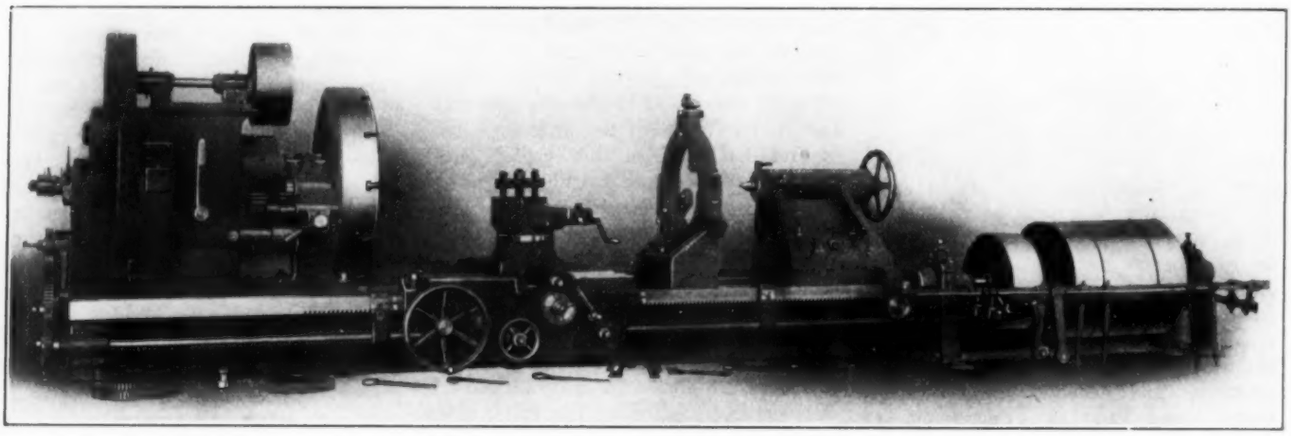
New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

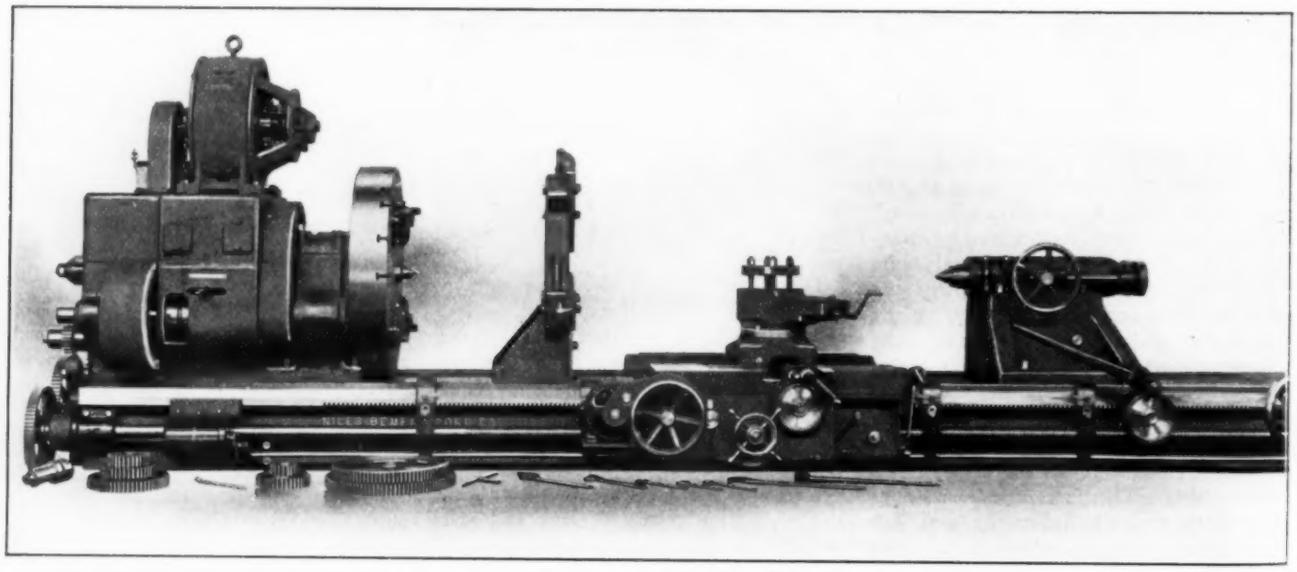
THE LATEST INFORMATION

Two Large Lathes

These are both geared-head lathes, the smaller being belt driven from a two-speed countershaft, or can be supplied with motor, if desired. It swings 49 inches over the bed and 39 inches over the carriage; with a 16-foot bed it will turn 7 feet between the centers. The gearing in the head gives six changes through substantial wide-faced gears and positive clutches. All shafts run in bronze bearings and have large oil wells and self-oiling rings. The tailstock has the usual set-over, and is moved on the way by gears and pinions engaging in the rack. The bed is made wide enough to support the tool without any overhang even when turning the largest diameters. Flat ways are provided unless V's are ordered; the carriage has long bearings, is gibbed to the outside edges of the bed and can be clamped when cross-feeding.



48-INCH GEARED HEAD LATHE



60-INCH GEARED HEAD LATHE WITH MOTOR ON THE CARRIAGE

The tool slide has a compound rest and the carriage is provided with the usual screw-cutting and friction feed, which are interlocking, so that both cannot be engaged at the same time. The direction of feed can be changed from the carriage apron. The screw-cutting attachment and feeds are connected to the live spindle by three gears and a sliding key, which gives three feed changes without changing any gears. The carriage gearing is driven by a spline in the lead screw and the thread is used only for screw cutting. When this is being done, the feed rack can be disengaged to prevent any disturbance in the movement of the carriage. Taper-turning attachment and power angular feed can be supplied when desired.

THE 60-INCH LATHE

The larger 60-inch forge lathe is shown motor driven, but can be supplied either way, as desired. This swings 61 inches over the bed, 46½ inches over the carriage, and with an 18-foot bed will turn 65 inches between centers. This has a very similar headstock to the other lathe.

except that it is larger and heavier in every way, but it contains six changes, as before. Further speed changes are secured by using a variable-speed motor, or a two-speed countershaft, according to the drive used. The motor can be controlled from the carriage so that the lathe can be started, stopped, or reversed, and its speed varied without changing its position. The face-plate spindle has a thick flange of large diameter, to which the face plate is bolted in addition to being forced on. The tailstock has the usual set-over and is provided with a pawl which engages a rack in the bed to assist the clamping bolt in resisting end thrust. It also has the ratchet-operated gearing for moving it along the bed. The design of the bed is very similar to the other lathe described, but the carriage is provided with an independent motor for moving it to any position desired. Both of these lathes are built by the Pond works of the Niles-Bement-Pond Company, Plainfield, N. J.

An Adjustable Rigid Journal Bearing

That journal-bearing troubles are common the world over is testified to by the fact that this new journal bearing, having an adjustable and self-adjusting split sleeve, was developed in Chile to do away with bearing troubles on wood-working machinery. The inventor and introducer into this country is William Kupfer, of Santiago, Chile, with an American address at 79 Wall street, New York City, care of Kates & Bok. Bearings of this kind have been in use for over five years in Chile on shafts up to 4 inches in diameter; the applications were mainly on wood-working machines.

The half-tone, Fig. 1, shows this type of bearing. Each bearing consists of a cast-iron frame or housing, which need have no finish or machine work aside from snagging and tapping a few bolt holes, and an adjustable and self-adjusting bearing sleeve. There are two general types; the one, with the split in the sleeve in a horizontal plane, adapted for a vertical force; the other, with the split of the bushing in a vertical plane and thereby adapted for a horizontal belt pull.

The line engraving, Fig. 2, shows a longitudinal and transverse section of one of these bearings with reference letters. The frame housing needs no comment other than to note the absence of machine work. The sleeve is adjustable in that

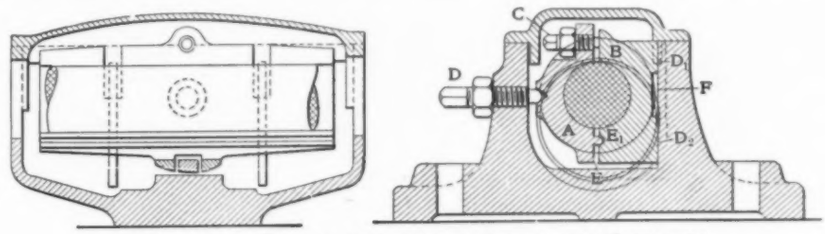


FIG. 2. SECTIONS OF NEW BRONZE-LINED JOURNAL BEARING

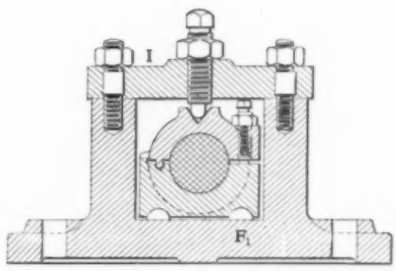


FIG. 4. HOUSING ARRANGED FOR SLEEVE WITH SPLIT IN HORIZONTAL PLANE

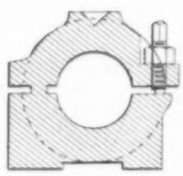


FIG. 3. ANOTHER TYPE OF MACHINE

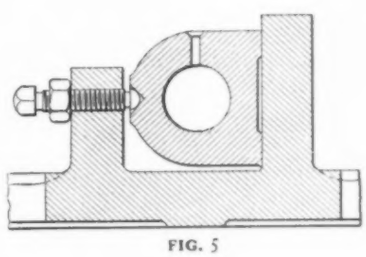


FIG. 5

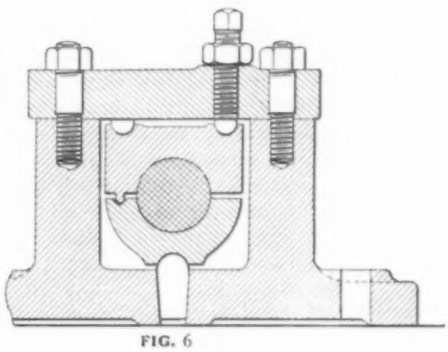


FIG. 6

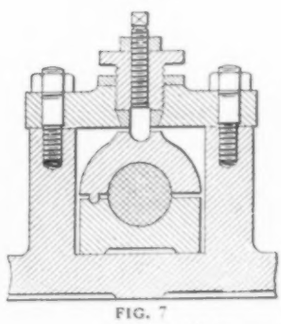


FIG. 7

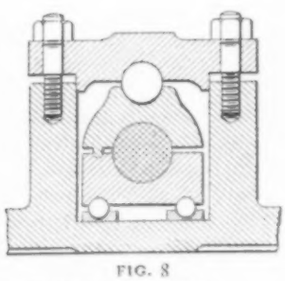


FIG. 8

MODIFICATION OF PRINCIPLE OF TRIANGULAR SUPPORT

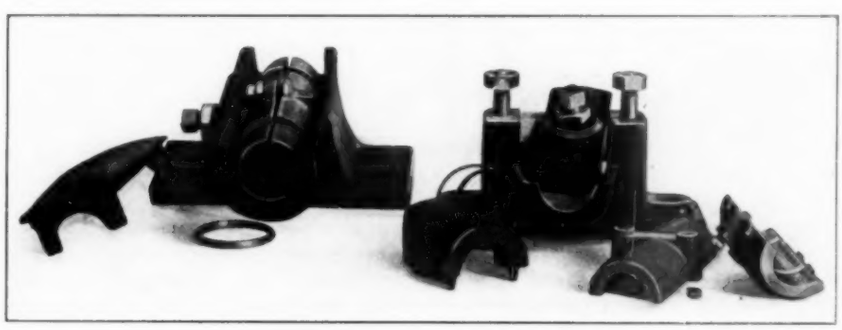


FIG. 1. A NEW TYPE OF JOURNAL BEARING

it is made in two sections or halves, *A* and *B*, fitted together by a specially shaped tongue and groove on one side, and held apart by an adjusting screw on the other side at *C*. The groove at E_1 is V-shaped. The tongue at E_2 is rounded. There is a certain amount of clearance between the two sections *A* and *B*, as shown at *E*. The adjusting screw *C*, which is tapped into the part *A* and bears against a lug on the part *B*, determines the relative position of the two sections. The construction of the tongue and groove at E_1, which we have described, allows the two

parts to come to a perfect bearing at any point within the limit of the adjustment of the adjusting screw *C*. It will be seen that this contact between the two halves of the sleeve is a type of three-point contact, or triangular contact, which is best described as a line and point contact along the base line and at the opposite vertex of a triangle. The self-alining advantages of such a type of contact are well known.

The same principle is used for holding the sleeve in the cast-iron frame or housing. There is in effect a line contact or, to be exact, contact over very narrow vertical faces at D_1 and D_2, and a holding screw on the opposite side at *D*. The effect of this combination is a triangle with its base line at D_1 and D_2 and its opposite vertex at *D*. The sleeve is adjustable for the degree of clearance between its inner bearing surface and the surface of the shaft which passes through it by means of the checked screw *C*, as we have described. At the same time the sleeve as a whole is self-adjusting within the limits of design in both a vertical and horizontal direction, by means of its point and line bearing within the housing; thus our characterization of the bearing as a bearing with an adjustable and self-adjusting sleeve to the shaft and in the housing.

Fig. 3 shows a modification of the sleeve, in which it is slitted through the wall into the bearing space on one side, and only slitted partly through on the other. The technical effect is substantially the same as for the split sleeve which we have described. Fig. 4 shows a bearing with the split in the sleeve in a horizontal plane. The line contact between the bearing housing and the sleeve, which we described in connection with Fig. 2, is here replaced by two half balls, indicated at *F*. Thus it becomes adjustable to the surface of the housing. The general self-adjusting feature of the bearing is the same as for the type described in connection with Fig. 2. Figs. 5 to 8, inclusive, show four other modifications of this same principle. The illustrations are so clear as to need no detailed description. The type of sleeve shown in Fig. 2 is preferred, as it is cheaper to manufacture than the others. After the sleeve has been once properly adjusted to a shaft it can be removed at any time from the frame and replaced in exactly the same adjustment, for the adjustment is in no way disturbed by the operation of removing and replacing.

The sleeves may be of bronze, or lined with babbitt, or made of any suitable metal.

The bearing is designed for severe conditions of service on machinery in general, although in its simplest form Fig. 5, it is well adapted for power-transmission purposes, machine countershafts and the like.

Any approved method of lubrication may be used; that shown in Figs. 1 and 2 is the well known ring-oiling type.

A New Geared Drive

This has been designed so that it has a geared speed, or driving box, to be used either as an auxiliary, or built into any machine tool. At the present time it is driving a large boring mill in the shop of the Baush Machine Tool Company, Springfield, Mass., and it is the design of Frank E. Bocorselski, who is their superintendent. It is, of course, subject to a number of modifications to suit different conditions, but in the illustrations shown it gives five speeds ahead and a reverse.

If a belt drive is to be used, gear *B* is replaced by a pulley, or a motor can be mounted directly on the cover and drive through the gear *B*. The driving shaft carries gears 1, 2, 3, 4, 5 and 6, which mesh with their corresponding gears on the secondary shaft, from which power is transmitted to the machine through the gear *C*. Each of the gears on the secondary shaft has an annular groove for the clutch ring shown in the sectional views, and these rings are expanded into either one gear or the other by the movement of the lever *F* on the outside of the case.

The fork which controls the clutch spreader is pivoted just inside the case, and its outer end is controlled by a cam groove on the hub of the lever *F*. This cam is so arranged that one movement of the lever throws the clutch spreader to the right, and the opposite movement throws it to the left. In this way each of the levers gives two speeds to the secondary shaft, but in the case of the lever at the extreme left, one train of gears carries an idler which gives the reverse motion to the secondary shaft, when the lever is thrown in the right position. Each lever is locked in its central position by the spring pin shown.

The section views of this geared drive

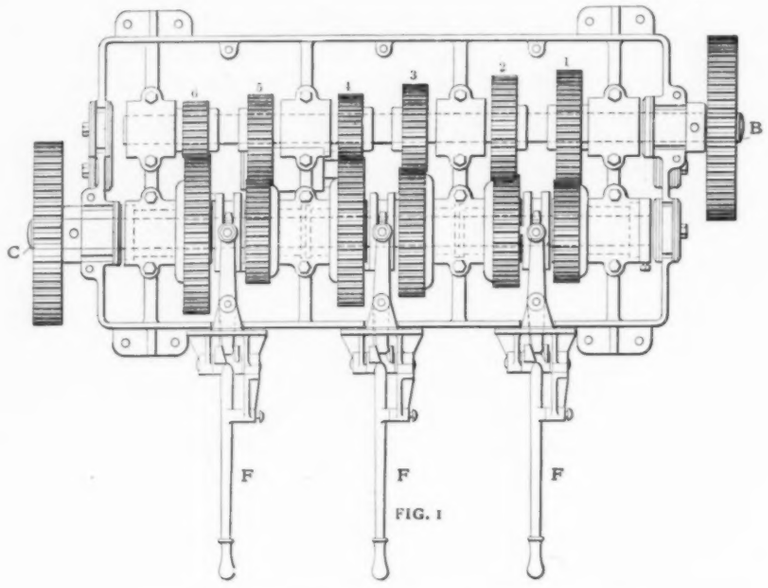


FIG. 1

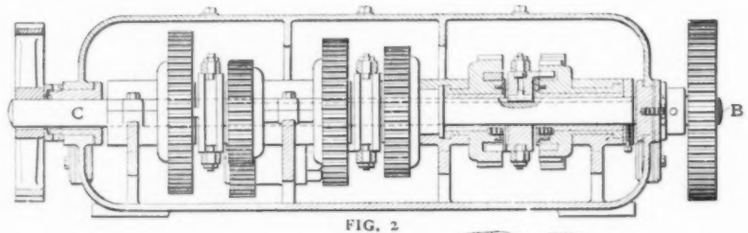


FIG. 2

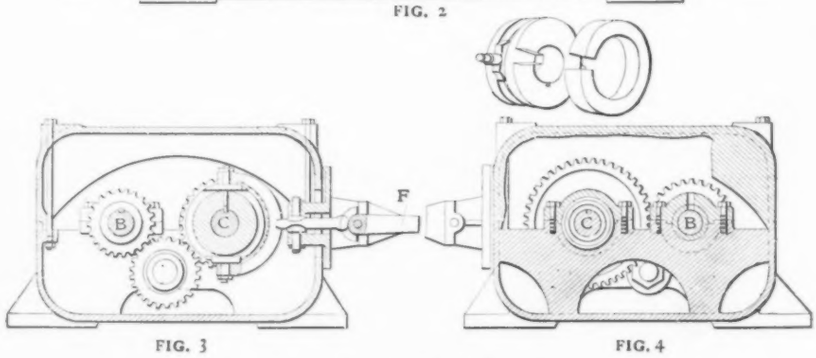


FIG. 3 FIG. 4

A GEARED SPEED BOX

show its substantial construction, and as it continually runs in oil, it is not only quiet, but does not show excessive wear. As will be seen, there is a bearing between each pair of gears, so that both the main and secondary shafts are well supported. The operation is easy, and although it is possible to obtain almost any range of speeds desired in this way, these are arranged in geometric ratio, as being most desirable for ordinary use.

A New Cam Cutting Machine

While this machine has been designed especially for cutting cams for textile machinery, it can be used for any other kind of work, and is extremely stiff and rigid in all its parts. The twin headstocks have ample bearings, and instead of depending entirely on the worm wheels at the back end of the spindles, the face plates are also geared together through an idle pinion, so as to avoid torsion in the spindles themselves. The spindle bearings are 5½ and 5 inches in diameter, respectively, and of sufficient length to insure stiffness.

The former is bolted to the further face plate, while the cam to be cut is held on the one in front so as to be operated on by the milling cutter, driven by the independent belt wheel shown. The milling cutter is fed in and out of the work by the worm shown, operating through a rack on the underside of the cutter slide. The follower or forming roll is mounted in a somewhat similar slide and is fed into the former by the small ball handle shown. These heads are mounted on the cross-slide, so that their center distances are the same as those of the twin spindles, and the cross-slide is free to move in either direction under control of the master cam. It can also be moved by hand by throwing in the racquet lever, shown hanging down in front of the machine. Some of the cams usually cut are shown in Fig. 2 and are 20 inches in diameter, with the cam groove 1 inch wide and ⅜ inch deep, with a 3-inch rise and fall at the different points. These are finished in two cuts and average 15 minutes to each cut.

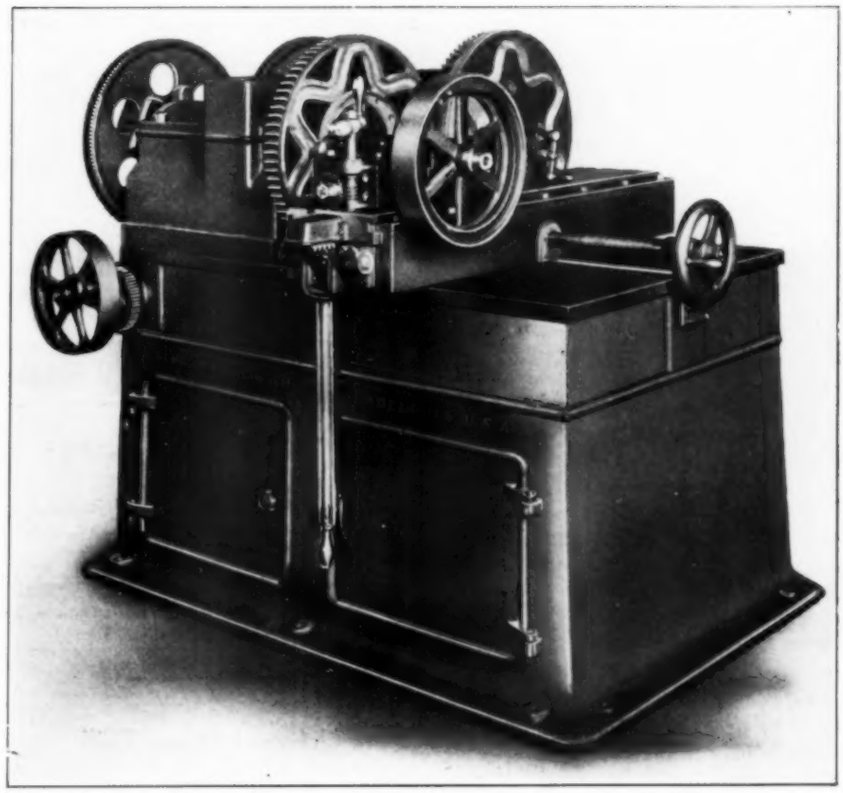


FIG. 1. LARGE CAM CUTTING MACHINE

Fig. 3 shows three of the former cams used on this particular work, and also the method of producing them. The three cam plates, shown above the master cams, are laid out very accurately and drilled with the required number of index holes, so as to enable them to be moved around into different positions and to allow cams having a varied number of lobes to be cut from the same master cam plate. These are used in cutting the master cam plate, and as can be readily seen, it reduces the number of master cams necessary to produce a variety of shapes.

In Fig. 4 is shown a detail of the

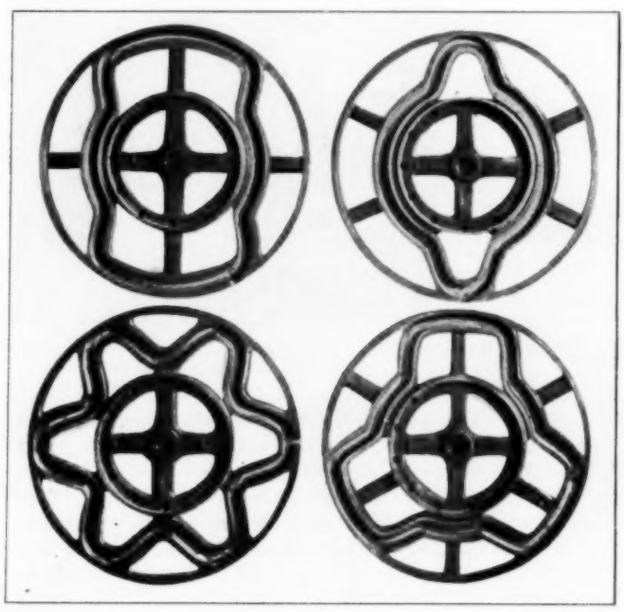


FIG. 2. SOME OF THE CAMS CUT

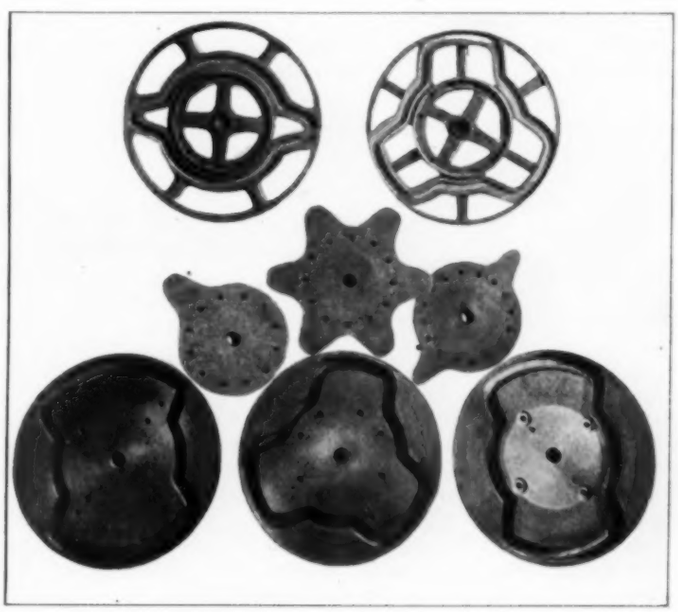


FIG. 3. THE MASTER CAMS

method of preventing lost motion in the former pin. This pin has two eccentric bearings which are somewhat exaggerated in the sketch and carries two rolls tapered to fit the groove in the former. In this way one roll bears on one side of the

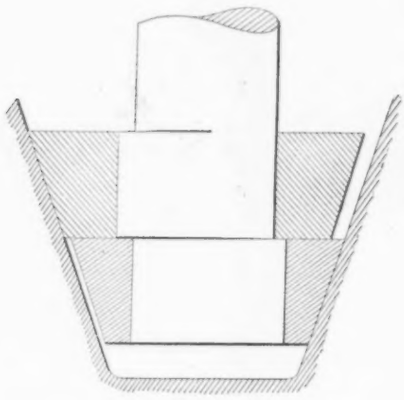


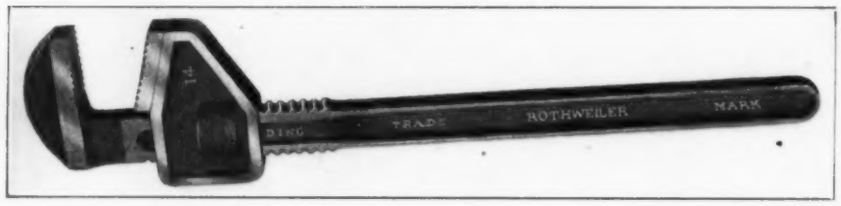
FIG. 4. DETAILS OF GUIDE ROLLER

groove, while the other prevents lost motion by bearing on the other side, and the pin is held in the groove by a spring under compression. This makes it possible to have a good bearing against both sides of the groove and still avoid all wedging or sliding action.

This machine can also be arranged to cut barrel or peripheral cams, and is built by the Fay Machine Tool Company, Second and Glenwood avenues, Philadelphia, Penn.

The Drop-forged Rothweiler Pipe Wrench

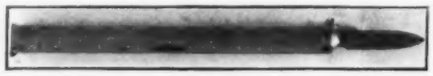
The operation of this wrench is made so plain by the illustrations that very little description is necessary. There are only six parts to the whole wrench, including the spring and pin, which are inserted between the lower jaw and the gripping piece so as to always bring the sliding jaw back into position, after it has automatically moved down the incline to release the pipe. The whole wrench is drop forged of tool steel, which gives a very powerful wrench of comparatively light weight. It is made by the Crescent Forgings Company, Oakmont, Penn.



A DROP-FORGED PIPE WRENCH

A Small Hollow-ground Machinist Scraper

Nearly every machinist occasionally has use for a small scraper and usually grinds the end of a three-cornered file for that purpose. The tool shown is, so far as we know, the first standard or commercial scraper of this kind to be put on the market and will be appreciated by many. The

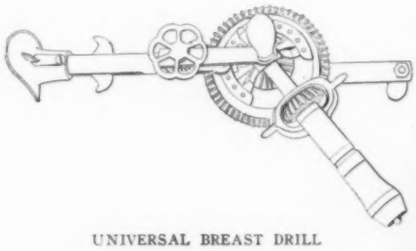


SMALL SCRAPER FOR MACHINIST

handle is hollow to make it light, and is nurled to give a firm grip in any position. The sides are hollow ground and it makes a very neat little tool for the machinist's kit. It is made by J. E. Poorman, 1722 St. Paul street, Philadelphia, Penn.

Universal Breast Drill

This combines the advantages of a breast and ratchet drill with the very



UNIVERSAL BREAST DRILL

handy feature of being able to drill at any angle by swinging the spindle, as shown. On straight work, or where the drill spindle can be braced to carry the strain, a screw feed is provided the small handwheel at the side. There are two sets of gears, all of which are cut and the sweep of the handle is adjustable.

The handle has an opening for a chain which rests on the brackets shown and allows the drill to be held in place against a pipe or other work. It is made by the Lancaster Machine and Knife Works, Lancaster, N. Y.

Steel Trestle or Horse

The engraving shows a steel trestle or horse built up from standard steel shapes with the exception of the center web or bolster, and which makes a very light and substantial piece of shop furniture. The top is 36 inches long and stands 30 inches from the floor, while the whole thing

STEEL TRESTLE OR HORSE

weighs but 44 pounds and has a carrying capacity of two tons. This is made by Reinhold Betterman, Johnstown, Penn., who has applied for a patent on it.

A Handy Drift for Drills

This is a very simple device which should be found extremely useful in any shop where drifts are used for removing drills or any similar tools from taper sockets. It consists of a hardened steel

A DRILL DRIFT

blade with a heavy cast handle, which slides on it and acts as the hammer with which to force the drift into the slot. By placing the drift in the slot, then drawing back the handle and driving it home over the steel blade, a sharp and effective blow is secured, which is said to be sufficient to loosen even the most stubborn drill. It is made by the Automatic Drill Drift Company, Springfield, Ill.

The Centrip Gear

By Arthur W. Jones

This is a totally inclosed, double-reduction, fixed-ratio gear with straight-line transmission through countershafts in triplicate placed concentrically round the main axis. Hence the trade name "Centrip." In principle it is a perfectly plain straightforward double-reduction spur gear with limiting possibilities of speed change corresponding thereto. In construction it differs materially from the ordinary open double-reduction gear which is not commonly carried out as a straight-line transmission, rarely with the efficiency and never with the compactness of the Centrip mechanism. The last named feature is well brought out by Fig. 1 which is an application with a three-phase induction motor of 25 horse-power capacity at 585 revolutions per minute, reduced by the Centrip gear to 26 revolutions on the main and tail rope colliery haulage drums, a reduction of 22.5 to 1.

Attention is particularly drawn to the fact that the overall dimensions of the Centrip gear are commensurate with those of the motor.

High efficiency is attained by the use of ball bearings throughout, by the adoption of shortened gear teeth and by total inclosure within its oil bath; features conducing to the reduction of friction losses. Straight-line transmission is incidental to the use of three countershafts and could not be avoided, it may be an advantage or otherwise according to circumstances. It tends to reduce considerably the width of the floor space at the cost of a slight increase in length.

sible for the first reduction, and then only with infinitely fine teeth, is 6.45 to 1 at which the wheel pitch line circles subtend 120 degrees in the pinion axis. Hence with workable pitches the first reduction must necessarily be less than this, but by the adoption of stub teeth it can ordinarily be made up to 5.5 and occasionally up to 5.75 to 1. The second reduction is not limited in the same way but only by the

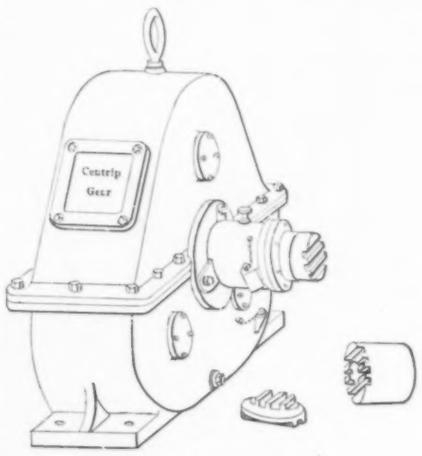


FIG. 3. A "CENTRIP" GEAR

minimum number of teeth considered desirable for the pinions. Economically, that is from the point of view of consistent distribution of material, it has been found desirable to make the first reduction exceed the second reduction for large gear ratios and to make the first less than the second for small gear ratios.

The external appearance of the gear is well shown by Fig. 3, and the detail construction by Figs. 4 and 5, respectively end elevation and vertical cross-section.

shaft which at its other end carries the half coupling also integral therewith. This shaft is of nickel steel with the pinion end case-hardened and runs in ball bearings. The fluted coupling with floating plate is used to preclude the possibility of putting the short shaft in twist.

Meshing with the high-speed pinion are three wheels carried on countershafts running in ball bearings. One of the wheels, the upper one, is keyed solid, the other two are adjustably bolted to fixed centers for the purpose of securing perfect equality of load on the three sets of gears. The countershafts are swelled out to allow the second-motion pinions to be cut from the solid as their dimensions also are usually too small for boring and fixing with standard keys. These three pinions are case-hardened. The ball bearings are of standard type and call for no special remark other than that a big one is used at the pinion end where the load is greatest and that both are several sizes larger than the makers consider adequate for the actual load imposed.

As the slow-speed wheel is equally driven by three pinions it transmits pure torque—free from side thrust—and is therefore appropriately carried on the overhanging end of the drum shaft for which no special bearing attached to the gear case is necessary. The inclosing gear box is in two pieces bolted together on the center line of the main axis. The upper portion carrying the solid countershaft is readily detachable and its removal interferes with no other part. The lower half carries the high-speed bearing and the two-bolted countershafts and is provided with oil sight-gage and drain plug. A hand hole is provided for inspection and filling with oil.

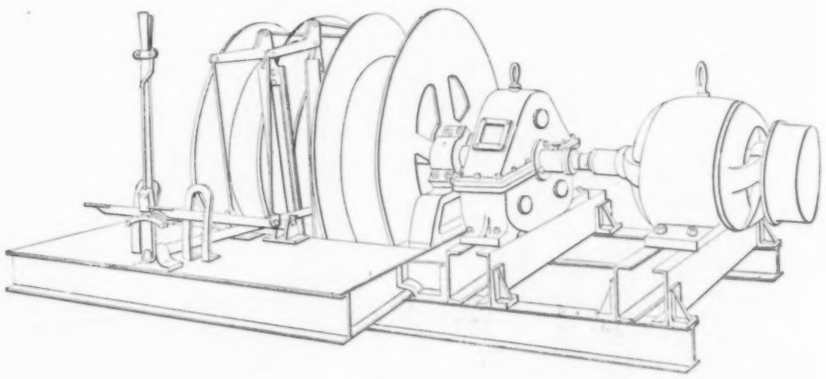


FIG. 1. A "CENTRIP" GEAR BETWEEN A MOTOR AND HOISTING DRUMS

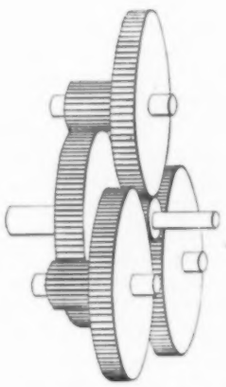


FIG. 2. ARRANGEMENT OF THE GEARS

Fig. 2 serves diagrammatically to illustrate the principle of the gear. The first reduction is from the single motor or high-speed pinion to the three countershaft wheels and the second from the three pinions to the single slow-speed wheel. The countershafts are spaced at 120 degrees around and equidistant from the main axis and it arises from this that the maximum gear ratio theoretically possible

The use of three second motion or countershafts, together with the choice of steel as the material of the wheels, makes it practicable, without unduly increasing tooth loads or exceeding permissible stresses, to so reduce the dimensions of the high-speed pinion that it becomes ordinarily too small to bore and key to a normal shaft. The pinion is, therefore, forged on one end of the short high-speed

Sizes

The gear is manufactured in 4-, 5-, 7-, 9- and 11-inch radial center distance sizes and is standardized for 10, 15, 20 and 25 to 1 reductions from the British Engineering Standard electric-motor speeds corresponding to the normal transmitting capacities. Thus the 9-inch gear from an initial speed of 750 revolutions per minute will, with a reduction of

10 to 1, carry 50 horse-power at 75 revolutions per minute.
15 to 1, carry 40 horse-power at 50 revolutions per minute.
20 to 1, carry 30 horse-power at 37.5 revolutions per minute.
25 to 1, carry 25 horse-power at 30 revolutions per minute.

With other initial speeds, not widely differing from the standard, the capacity with any given reduction is roughly proportioned to the speed. All the gear cases are designed to carry wheels 25 per cent. wider than the standard face widths so that intermediate requirements can be met by a mere change of wheels.

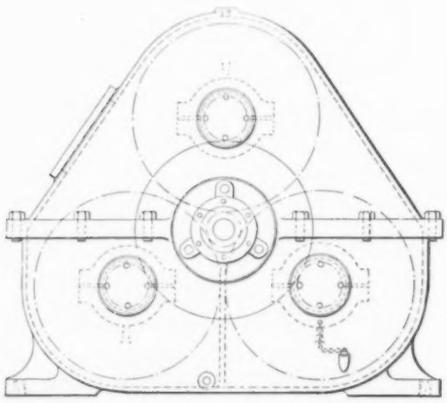


FIG. 4.

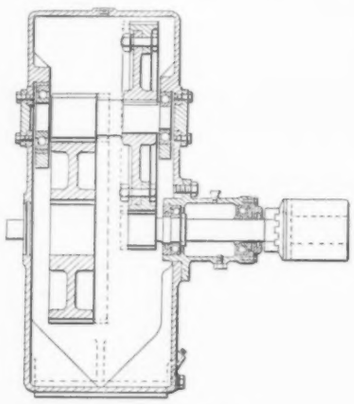


FIG. 5

DETAILS OF A "CENTRIP" GEAR

Important Features

Some of the important features embodied in the Centrip gear are: The high- and low-speed shafts are in line and abut closely; all wheels and pinions are machine cut from solid steel blanks; the high-speed pinion is of nickel steel; all pinions are case-hardened; the gear is totally enclosed and runs in an oil bath; there is no side thrust whatever on either high- or low-speed shaft bearings which merely serve to center the gears. These bearings are consequently almost frictionless; the countershaft journals which do carry side thrust run in standard ball bearings copiously lubricated and proportioned to the loads carried, but in all cases larger than those actually called for on normal rating; with triple gear contacts the dimensions of all wheels are so reduced that the meshing velocities are usually less than one-half of those in open double-reduction gears (they are less than one-quarter of those in some epicyclic reducing gears); consequent on the foregoing—elimination of friction and slow meshing speeds—the mechanical efficiency is high and the life should be indefinitely prolonged; the whole gear is compact and the outside dimensions for ordinary reductions are commensurate with those of standard motors.

There are 17 industrial schools in Chile, with a total attendance of 3,195 pupils, covering all lines of industry. The Chilean government contributes liberally for this work.

An Unusual Broaching Job

Some of the possibilities of broaching are shown by the accompanying illustrations of a piece of work being done on the machine of the Lapointe Machine Tool Company, Hudson, Mass. The work itself is an elliptical steel casting having a box-like opening as in Fig. 1. This is all broached except the grooves in the center of each side, and tapers outward ½ inch from each corner. The cut must start from the bottom in a shallow recess 3 inches long. The hole is approximately 8 inches square and the cut 14 inches long.

Fig. 2 shows the broach and the holder for the work. The broach is in four parts each sliding on one side of the mandrel, which is tapered to correspond with the hole to be cut and the four broaches are pulled together by the rods shown. These rods are so arranged as to allow the separation necessary as they are pulled up the incline.

To put on the work the broaches are moved to the extreme outer end of the mandrel and project half way over it. Then the work is slipped over it as in Fig. 3. Starting the machine pulls the broaches up the inclines and starts them at work. The chips taken out are shown in Fig. 2 on top of the holder and in the broach. The amount of stock removed is about 1/16 inch thick by 8 inches across or around the corner, and 14 inches long.

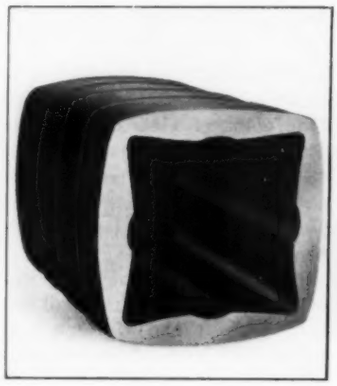


FIG. 1. THE WORK

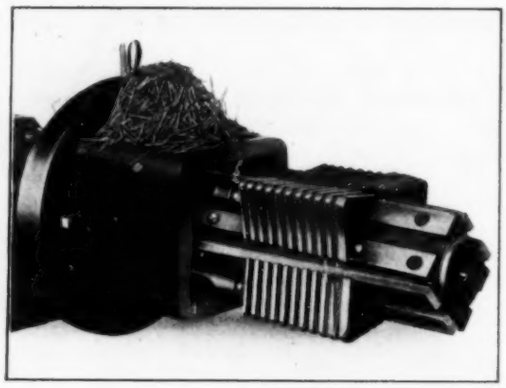


FIG. 2. THE BROACH AND HOLDER

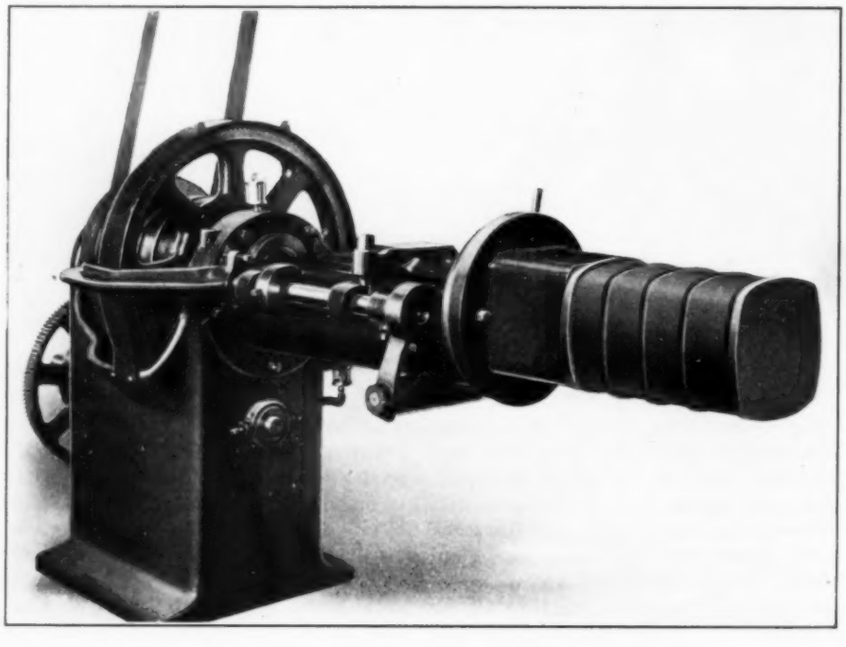
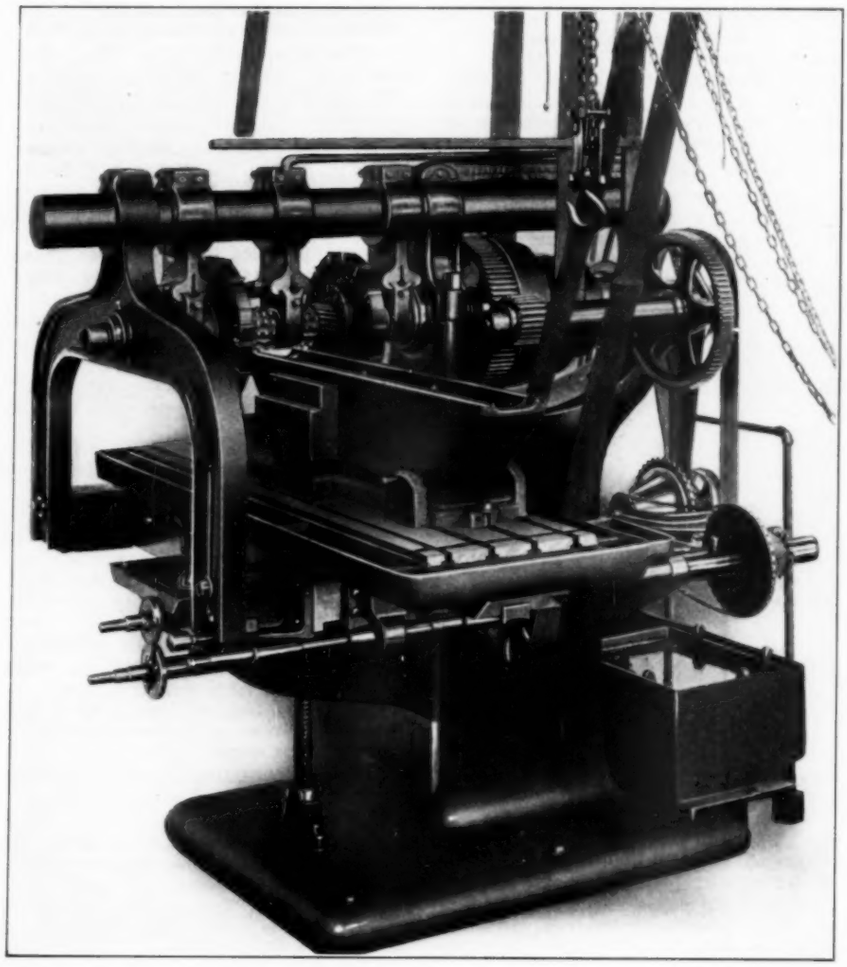


FIG. 3. THE MACHINE AT WORK

It is estimated by the builders that these four broaches require a pull of from 75 to 100 tons.

Bracing a Milling-machine Table

The accompanying photograph shows how a large Becker-Brainard milling machine was built over for the special job of milling the ways on the small planer bed shown mounted on the table. This is a bed for a small bench planer which is built by E. E. Bartlett, Boston, Mass., in whose shop this illustration was secured. To begin with, the overhanging arm is of hard, 80-point carbon steel, 5½ inches in diameter, which makes it extremely rigid to withstand all the shocks and vibrations put upon it.



BRACING A MILLING-MACHINE TABLE

At the outer end of this is the outside yoke or brace which differs from the usual design in being bolted to the carriage and not to the knee of the milling machine. This is done to secure increased rigidity, which is believed to more than make up for the heavy casting employed, and for the time of the extra adjusting which is necessary whenever the carriage is moved in or out on the knee. In such cases it becomes necessary to slack the two binding bolts so that the brace can be moved on the overhanging arm and to tighten them in their new position.

A new table has also been added which is 16 inches wide by 6 feet long and has an oil gutter 2½ inches wide and 3 inches deep running around the entire table. This large gutter enables them to keep a constant stream of oil or other lubricant on the cutters when desired, and this is returned to the reservoir or settling tank, shown at the back of the machine. This reservoir is the one commonly supplied by the Landis Tool Company with their No. 3 Universal grinder, and it is also fitted with a Brown & Sharpe rotary pump for forcing the lubricant to the cutters. The return is made through a rubber tube, which is not shown.

The table is driven by power, and is at present controlled by a hand-shipper, but it is the intention to have this automatic in the near future.

The face of the spindle gear has been increased from 2 inches to 3½ inches in order to insure transmission of all power necessary. It will also be noted that the milling cutters are mounted on an arbor, which is supported at the outer end by the brace, and also that there are three auxiliary supports between this and the main bearing of the machine. The method of adjusting the bearings is plainly shown, and in this way there should be little or no difficulty from the springing of the arbor.

An Index Die for Armature Punchings—Erratum

In the article at page 947, Vol. 31, Part 1, under the above title the value of R in the fifth line from the bottom of the first column and the seventh line from the bottom of the second column is given as 12 seconds, whereas it should have read 12 inches.

An Odd Way of Machining Crank-shafts

By John P. Wheeler

In these days of special crank-shaft lathes and grinding machines, it may interest some to hear how I saw a crank-shaft machined in an old fashioned English jobbing shop where I was first initiated in the gentle art of making chips.

The job in question was a four-throw crank-shaft for a diving pump. The forging was made by the local blacksmith, and was bent up out of 1¼-inch round steel. He must have been a pretty good smith by the way, for it was a beautiful job, as good as most drop-forgings. The throws, as I remember, were proportionately long—about 6 inches, and the cheeks of each were inclined about 10 degrees from the axis, making it rather awkward to pack while turning the pins. This, however, was far from the thoughts of the old mechanic who did the machining. His first operation after centering and squaring the ends was to take a light cut over the top of each throw till they were all even and about 1/16 inch longer than the finished size. He then finished the ends and bearings. The next operation staggered me at first. He took it to the vise and *filed* each pin as near round as he could, using the cut referred to as a guide, and leaving each pin ⅛ inch over finished size. He then made a pair of "clamp mills" to fit the largest die stock in the shop. He just soldered the blank dies together, bored them out in the lathe to the finished size of the pins, and filed them out like a female milling cutter, except that the lands were about 1/32 inch and not backed off at all. After hardening, he lapped it out to size in the die stock, and then proceeded to mill the pins down by hand, feeding very light, and occasionally testing with the square, till the dies were tight together. The finish was like a mirror, though I had some doubts as to its accuracy. The boss, however, seemed to have no such doubts. The crank-shaft was mounted in its proper position and the machine delivered. As these machines are tested in the most

exhaustive manner (the diver's life depends on the pump) and we never received a complaint, it is only fair to suppose the job was all right.

[The cranks used in textile work are very commonly finished from the rough forging with a clamp mill but used in the lathe.—ED.]

To Keep Brass Chips from Flying

BY D. T. FLETCHER

A friend of mine, while working in a railroad locomotive shop years ago, ran a lathe, turning hub plates. In order to save the chips, he stuck the ordinary pasteboard "back stop" on the lathe tool. Finding that piece-work speed, and depth of cut, threw most of the chips on the floor, and some on himself, he thought that he would improve the chip stopper by making

FIG. 1

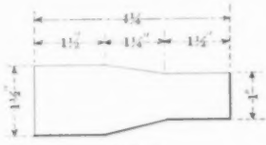


FIG. 2

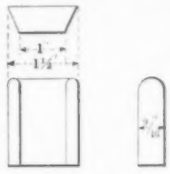


FIG. 3

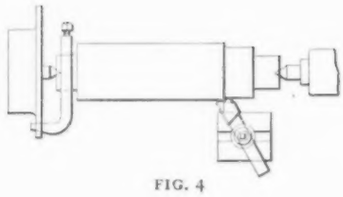


FIG. 4

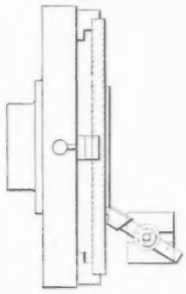


FIG. 5

A UNIVERSAL BRASS CHIP STOPPER

all of the chips hit the pasteboard. He, therefore, took a piece of tin, 1x3 inches, bent it into a U-shape, as in Fig. 1, with width *A* a little wider than the lathe tool. He expected the chips to fly right through the arch way, and hit the pasteboard. But they filled the arch and the new chips came in at the front end and flowed through the tunnel slowly and then off of the tool, dropping into the lathe pan so the pasteboard was not needed.

Finding that this chip stopper worked best when it was loose enough to slide out to the end of the tool against the work, he made several of them. Making one out of No. 20 gage sheet metal as in Figs. 2 and 3, he named it the universal brass chip stopper, as it could be used on either cylindrical or flat work, and with the tool set either to feed right or left. Fig. 2 shows the blank, and Fig. 3 the blank bent ready for use. Figs. 4 and 5 show the stopper used in different positions.

Business Items

The note in June 18 issue regarding the fire of the Best Manufacturing Company, Pittsburg, was erroneous. This company advises us that the fire did very little damage to their plant, not enough to interfere with operations.

The U. S. Gas Furnace Company, Providence, R. I., has completed a full line of gas blast furnaces for annealing and tempering, melting, etc., bench forges, pressure blowers and pryometers, and owing to the rapid increase in their business has been compelled to move from Aborn street, where they started, to larger quarters at 143 Eddy street.

Trade Catalogs

Cincinnati Shaper Company, Cincinnati, Ohio. Catalog F, describing shapers. Illustrated, 72 pages, 6x9 inches, paper.

Standard Gauge Manufacturing Company, Syracuse, N. Y. Bulletin No. 2, describing pressure and vacuum gages. Illustrated, 36 pages, 8x11 inches, paper.

The Triumph Electric Company, Cincinnati, Ohio. Bulletin No. 341 showing the application of Triumph motors to lathes, planers, presses, etc. 32 pages, 6¼x10 inches, paper.

Brown Hoisting Machinery Company, Cleveland, Ohio. Catalog O describing machinery for the handling of coal, coke, etc. Illustrated, 22 pages, 6x9 inches, paper.

Iszard-Warren Company, Inc., 1122 Vine street, Philadelphia, Penn. Catalog of Sterling surveying instruments and drawing materials. Illustrated, 228 pages, 6x9 inches, paper.

U. S. Gas Furnace Company, Providence, R. I. Catalog of annealing and tempering furnaces, high-speed steel furnaces, melting furnaces, bench forges, pressure blowers and pyrometers. Illustrated, 12 pages, 6x9 inches, paper.

Cincinnati Punch and Shear Company, Cincinnati, Ohio. Catalog No. 11, describing bending and straightening rolls, punching machines, rolling mill and tin-mill machines, shears, etc. Illustrated, 64 pages, 6x9 inches, paper

General Electric Company, Schenectady, N. Y. Bulletin No. 4590 illustrating and describing self-starting devices for alternating current motors. 8 pages, 8x10½ inches. Bulletin No. 4593 showing apparatus for railway sub-stations. Illustrated, 26 pages, 8x10½ inches.

Business Opportunities

The LeRoy (N. Y.) Cotton Mills will erect an additional building.

The Republic Box Company, New Orleans, La., will enlarge plant.

Fire at the plant of the Richmond (Va.) Stove Works, caused a loss of over $100,000.

It is reported that Selden S. Deemer, of New Castle, Del , will build a $150,000 steel plant.

The Christy Knife Company, Fremont, Ohio, is arranging to establish a factory in England.

The Lowland Worsted Company, Woonsocket, R. I., is building a two-story addition.

The Salt Lake & Ogden Railroad Company will build car and repair shops in Ogden, Utah.

The Davis Mills, Fall River, Mass., manufacturing cotton goods, will put up another mill.

The Erie Foundry Company, Erie, Pa., whose plant was recently burned, is planning to rebuild.

The Killing Molding Machine Company, Davenport, Iowa, will erect a new foundry.

The Freyer Trunk Manufacturing Company, Houston, Tex., will erect a modern three-story factory.

The Adjustable Table Company, Grand Rapids, Mich., is erecting a new $20,000 factory.

E. P. Dobbs, Marietta, Ga., will establish a cannery with a capacity of 18,000 cans per day.

The Lumb Knitting Company, Pawtucket, R. I., is erecting an additional mill. Electric power will be used.

It is reported that the Tips Foundry Company, Albany, Ga., will enlarge the gasolene engine plant.

W. J. Savage & Company, Knoxville, Tenn., mill builders and machinists, will erect an additional building.

It is reported that the Great Falls (Mont.) Iron Works will erect a two-story machine shop to cost about $10,000.

The Eclipse Feed Water Heater and Purifier Company, of Appleton, Wis., will remove its plant to Oshkosh.

The Newman Lumber Company, Hattiesburg, Miss., whose plant was recently burned, will start rebuilding shortly.

The Lyman Mills, Holyoke, Mass., has awarded contract for the erection or another mill, which will cost about $150,000.

F. S. and F. A. Thompson, of Coyle, Okla., are forming the Thompson Canning Company, and will establish a plant.

The American Column Company, Battle Creek, Mich., is having plans drawn for the enlargement of its plant.

G. W. Fifield, Lowell, Mass., has taken out a permit for a machine shop to replace the one burned some time ago.

The plant of the Frost Veneering and Seating Company, Antigo, Wis., has been burned, causing a loss of about $50,000.

Fire destoyed the sawmill and stored lumber of the Kaul Lumber Company, at Hollins, Ala., causing a loss of nearly $500,000.

The Fayetteville (Tenn.) Plow Works has been organized to manufacture double shovel and cultivator invented by W. T. George.

The American Steel Wheel Company, Alexandria, Ind., formerly the Keefer Iron and Steel Company, will erect additional buildings.

The crate and barrel plant of the Farmers Manufacturing Company, Norfolk, Va., was destroyed by fire. Loss, about $100,000.

The plant of the Flint-Lomax Electric and Manufacturing Company, Denver, Colo., was destroyed by fire. Loss, about $100,000.

The American Snuff Company, Memphis, Tenn., will erect a snuff and tin-can factory and also remodel box plant. About $100,000 will be expended.

The Hamilton Manufacturing Company, Columbus, Ohio, which builds pit-car loaders and coal and coke storage machines, has purchased site for a new plant.

The Crane Company, Chicago, Ill., is reported to have purchased land in Oakmont, Pa., a suburb of Pittsburg, on which a $1,000,000 plant will be erected.

The General Fireproofing Company, Youngstown, Ohio, is erecting a building to be devoted to the manufacture of steel office furniture and filing devices.

The Wisconsin Central Railroad has awarded contract for the erection of buildings at Superior, Wis., including roundhouse, machine shop, etc. E. W. Kalk, Chicago, Ill., chief engineer.

The Woodmanse Manufacturing Company, Freeport, Ill., will erect an additional building to be used for general factory purpose. The company manufactures windmills.

The Sargeant Manufacturing Company, Charlotte, N. C., recently incorporated, is said to be planning erection of mill for the manufacture of cotton yarns. Electric power will be used.

The McCord Manufacturing Company, St. Louis, Mo., will, it is reported, erect plant for manufacturing special tools for making plumbers' supplies and builders' hardware.

The Rich Hill (Mo.) Sewer Pipe Company, recently incorporated, will erect plant for the manufacture of sewer pipe flue lining, etc. Incorporators, G. G. Milgate, J. D. Fowler, etc.

The De Hart Steel Tire Company, Springfield, Mo., has been incorporated and will erect plant for the manufacture of steel tires. Capital $100,000. W. H. Hansell, Springfield, manager.

The pattern shop of the Nortmann-Duffke Foundry Company and the adjacent enameling plant of the Rundle Manufacturing Company in Layton Park, Milwaukee, Wis., were destroyed by fire.

The Kirby & Averill Manufacturing Company, Wampee, S. C., manufacturing hickory handles, contemplates installing machinery for making broom and agricultural-implement handles.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., making electric controling devices, is said to be preparing to manufacture other electrical specialties, including snap switches and lamp sockets.

The Vacuum Cotton Picking Machine Company, St. Louis, Mo., has filed articles of incorporation for the purpose of manufacturing a vacuum machine for picking cotton. Capital, $450,000. Incorporators: J. S. Thurman, C. W. Thurman, W. W. Conklin and others.

The Kansas-Colorado Railroad Company has been incorportated with $5,000,000 capital to build an electric or steam railroad from Cañon City, Colo., to Garden City, Kan. The general office will be in Pueblo. S. H. Atwater, of Cañon City, is one of the incorporators.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., July 20, for tool steel, drill rods, Tobin bronze, yellow metal, sheet copper, sheet brass, seamless brass and copper, tubing, metallic packing, lace leather, duplex chain blocks, etc., as per circular No. 452.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E.G.Smith Co., Columbia, Pa.

If you use small gears in large quantities, write Berry & Parker, Erie, Pa.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Wanted—One old style No. 13 B. & S. milling machine. First-class condition not absoutely necessary. Box 234, AMER. MACHINIST.

Wanted—Machinery or machine parts to build by contract. Ideas developed; drawings made. Address "A," care AMER. MACH.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Have you a March 7, 1907 issue AMERICAN MACHINIST? We'll give you a month's subscription, or thirty cents, and a Steel supplement for it. AMERICAN MACHINIST, 505 Pearl street, New York.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work tools, dies, etc. Blair Tool and Machine Works, West and Morris streets, New York City.

Wanted—A good working partner with small capital can secure interest in a well equipped machine plant, established over 20 years, located on line of P. R. R. and P. & R. railroads, between New York and Philadelphia. Write for particulars. "W.," AM. M.

We have an attractive proposal for a shop suitably equipped to build machine tools weighing 1300 to 4000 pounds. An ideal line for a profitable, permanent addition. Little competition. Box 258, AMER. MACHINIST.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CALIFORNIA

Foundry foreman, fifteen years' experience in big shops. Hustler, with understanding to bring best work out of employes. Wishes position again as foundry foreman in California. Box 263, AMERICAN MACHINIST.

CONNECTICUT

Foreman machinist wishes responsible position, experienced on engine and machinery of all kinds; excellent references. "J. R.," 7 Thomas St., East Norwalk, Conn.

ILLINOIS

Up-to-date tool room foreman desires change; experienced on design and construction of sub-press dies, and tools for manufacturing adding machines, cash registers and small arms. Age 30. Married. References furnished. Box 241, AMERICAN MACHINIST.

MASSACHUSETTS

Automatic machine designer, twelve years' experience. Box 260, AMERICAN MACHINIST.

Designer and engineer is open for position on manufacturing equipment, machine tools and special machinery. Thirty years old, twelve years' experience in shop and office; eight years as chief. Box 264, AM. MACH.

NEW JERSEY

Mechanical engineer; specialty, condensing apparatus, pumping machinery, etc., open for engagement. Box 274, AMERICAN MACHINIST.

Draftsman, 37 years' experience on special and heavy machinery; four years' on special automatic shop machinery; references. Box 275, AMERICAN MACHINIST.

NEW YORK

Expert mechanic, designer and executive, desires change; energetic and inventive. Box 276, AMERICAN MACHINIST.

Expert mechanic, constructor and designer for delicate electric and mechanical apparatus, executive ability, desires change. Box 254, AMERICAN MACHINIST.

Experienced and thoroughly practical shop man who is also a competent draftsman and designer, up to date in modern shop practice; desires responsible position. Box 277, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

INDIANA

Wanted—Five (5) first-class toolmakers. Box 255, AMERICAN MACHINIST.

MASSACHUSETTS

Production man for company manufacturing monkey wrenches and a line of special wrenches. Man preferred who has a successful record on this kind of work. Good opportunity for man who can produce results with piece work. Box 257, AMER. MACH.

MISSOURI

Wanted—Competent inspector; electrical machine manufacturing company; also assistant; state full particulars. Box 271, AMERICAN MACHINIST.

NEW JERSEY

Wanted—A superintendent, thoroughly up-to-date, with executive ability for a well established first-class machine shop near New York; one accustomed to building printing machinery preferred. Address, stating experience, references, age and salary desired. Box 270, AMERICAN MACHINIST

NEW YORK

Wanted—Forge-shop foreman experienced in drop forging and blacksmith's machine work. Box 273, AMERICAN MACHINIST.

Wanted—Several first-class toolmakers; bench hands preferred; state experience, wages expected, married or single and age. Box 147, Elmira, N. Y.

Wanted—As an assistant foreman, a first-class toolmaker who has had experience on building machinery and small tool work. Box 224, AMERICAN MACHINIST.

Wanted—General foreman for machine shop manufacturing special and automatic machinery, machine tools, etc. Must be thoroughly competent mechanic and experienced executive, with personality and push to produce results at minimum cost without friction. Exceptional opportunity for right man who can grow with progressive and rapidly developing business. Address, giving experience in full, also age, references, nationality and salary expected. Box 262, care AMER. MACH.

OHIO

Wanted—Superintendent and designer of screw machines and turret machinery. Box 217, AMERICAN MACHINIST.

Wanted—Screw machine hands for Cleveland automatic, Potter & Johnston and Warner & Swasey hand screw machines. State experience, wages and when available. Address, The International Harvester Company, Akron, Ohio.

PENNSYLVANIA

Foreman for erecting heavy machine tools; must be experienced on accurate machine tool work, with ability to increase production and efficiency; state age, experience and salary expected. Box 278, AMERICAN MACHINIST.

Drop die maker; correspondence solicited from a practical die maker fully competent to lay out swaging dies and make dies and trimmers for drop forgings; can do own hardening and experienced in getting out drop die work of tool steel; give reference, age and wages. Box 272, AMERICAN MACHINIST.

For Sale

For Sale—One second-hand Uehling Steinbart & Company pneumatic pyrometer complete with recording gage. Box 140, AMERICAN MACHINIST.

For Sale or Rent—Foundry, machine and wood working shop, also blacksmith shop, in fine village of 5000, with use of machinery. Fine opening for a good business. Box 227, Bergen, N. Y.

For Sale or royalty; automatic and lever numbering machine combined in one, prints odd or even, consecutive and repeats any number, 2, 3, 4, etc., up to 14 times, also repeating attachment; descriptive circular. Box 203, Chicago, Ill.

Alphabetical Index to Advertisers

	PAGE
Abrasive Material Co.	58
Acme Machinery Co.	71
Adams Co.	67
Almond Mfg. Co., T. R.	76
Alteneder & Son, Theo.	93
American Blower Co.	57
American Emery Wheel Wks.	58
American Gas Furnace Co.	55
American Pulley Co.	78
American Tool Works Co., 8 and	91
American Tube and Stamping Co.	93
American Watch Tool Co.	74
American Wood Working Machinery Co.	70
Ames & Co., B. C.	74
Armstrong-Blum Mfg. Co.	87
Armstrong Bros. Tool Co.	64
Automatic Machine Co.	93
Baker Bros.	68
Bardons & Oliver	70
Barnes Co., W. F. & John	14
Barnett, G. & H.	36
Baush Machine Tool Co. 3d cover	
Bay State Stamping Co.	86
Beaman & Smith Co. 15 and	76
Becker-Brainard Milling Machine Co.	23
Berry & Parker	81
Besly & Co., Charles H.	65
Betts Machine Co.	6
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	87
Bilgram, Hugo	82
Billings & Spencer Co.	86
Blaisdell Machinery Co.	89
Blanchard Machine Co.	68
Bliss Co., E. W.	25
Bliss Mfg. Co., E. C.	81
Blount Co., J. G.	58
Boston Gear Works	82
Boynton & Plummer	58
Bradford Machine Tool Co.	5
Bradley & Son, C. C.	70
Bristol Co. 4th cover	
Brown & Co., R. H.	76
Brown & Sharpe Mfg. Co., 43 and 4th cover	
Brown Hoisting Mchry. Co.	78
Brubaker & Bros., W. L.	58
Bullard Machine Tool Co.	35
Burke Electric Co.	85
Burr & Son, John T.	74
C & C Electric Co.	84
Caldwell & Son Co., H. W.	83
Cammel, Laird & Co.	81
Carborundum Co.	9
Card Mfg. Co., S. W.	16
Carpenter Thp & Die Co., J. M.	70
Carver File Co.	86
Case Mfg. Co.	78
Celfor Tool Co.	86
Cell Drier Machine Co.	81
Chambersburg Engineering Co.	71
Champion Tool Works Co.	75
Chicago Flexible Shaft Co.	66
Chicago Raw Hide Mfg. Co.	82
Chisholm & Moore Mfg. Co.	1
Cincinnati Elec. Tool Co.	87
Cincinnati Lathe & Tool Co.	75
Cincinnati Machine Tool Co.	24
Cincinnati Milling Mach. Co.	7
Cincinnati Planer Co.	28
Cincinnati Shaper Co.	94
Clark Cast Steel Cement Co.	81
Clayton Air Compressor Wks.	89
Cleveland Auto. Mach. Co.	18
Cleveland Crane & Car Co.	78
Cleveland Planer Works	74
Cleveland Twist Drill Co., 4th cover	
Clum & Atkinson	81
Coates Clipper Mfg. Co.	69
Coes Wrench Co.	14
Colburn Machine Tool Co.	63
Consolidated Press and Tool Co.	68
Cook Co., Asa S.	62
Crocker-Wheeler Co.	85
Crosby Steam Gage & Valve Co.	17
Curtis & Curtis Co.	87
Cushman Chuck Co.	76
Davis Machine Co., W. P.	92
Davis, Rodney	82
Desmond-Stephan Mfg. Co.	58
Detrick & Harvey Mach. Co.	74
Diamond Chain & Mfg. Co.	79
Diamond Machine Co.	36
Diamond Saw and Stamping Works	75
Dickinson, Thos. L.	36
Dill Slotter People	65
Dixon Crucible Co., Jos.	73
Druckleib, C.	89
Earle Gear & Mach. Co.	82
Eastern Machinery Co.	93
Eberhardt Bros. Mach. Co.	83
Edison & Swan United Elec. Light Co.	61
Elmes Engineering Wks., Chas. F.	93
Errington F. A.	77
Evans Friction Cone Co.	73
Excelsior Needle Co.	68
Farrel Fdry. & Mach. Co.	81
Fawcus Machine Co.	82
Fay & Scott	69
Fay Machine Tool Co.	67
Fellows Gear Shaper Co.	28
Ferracute Machine Co.	74
Firth-Sterling Steel Co.	55
Fitchburg Machine Works	29
Flather Planer Co., Mark	75
Foote-Burt Co., The	86
Fosdick Machine Tool Co.	16
Franklin Mfg. Co., H. H.	57
Franklin Portable Crane and Hoist Co.	79
Fulton Machine & Vise Co.	62
Gang Co., Wm. E.	87
Gardner Machine Co.	58
Garvin Machine Co.	92
Gem Mfg. Co.	68
General Electric Co.	84
General Fire Proofing Co.	72
Geometric Tool Co.	25
Gisholt Machine Co.	93
Gleason Works 4th cover	
Globe Mach. & Stamp. Co.	81
Goldschmidt Thermit Co.	81
Gorton Machine Co., Geo.	72
Gould & Eberhardt	62
Graham Mfg. Co.	62
Grant Gear Works	82
Grant Mfg. & Mach. Co.	58
Gray Co., G. A.	26
Greaves, Klusman & Co.	69
Grönkvist Drill Chuck Co.	76
Hammacher, Schlemmer Co.	49
Hardinge Bros.	75
Harrington, Son & Co., Edw.	79
Harrison & Knight Mfg. Co.	75
Hart & Cooley Co.	67
Hart Mfg. Co.	68
Heald Machine Co.	49
Heller Bros. Co.	80
Hendey Machine Co.	51
Henry & Wright Mfg. Co.	61
Hess-Bright Mfg. Co.	62
Hill, Clarke & Co. Inc.	91
Hill Publishing Co. 60 and	88
Hisey-Wolf Machine Co.	71
Hoefer Mfg. Co.	70
Hoggson & Pettis Mfg. Co.	75
Horsburgh & Scott Co.	83
Horton & Son Co., E.	76
Hunt Co., Robt. W.	58
Hurlbut-Rogers Machine Co.	74
Hyatt Roller Bearing Co.	87
Independent Pneumatic Tool Co.	89
Industrial Law League	71
Industrial Oxygen Co.	81
Ingersoll Milling Machine Co.	73
Ingersoll-Rand Co.	89
Iroquois Machine Co.	59
Jacobs Mfg. Co.	77
Jantz & Leist Elec. Co.	85
Johnson Machine Co., Carlyle	65
Jones & Lamson Mach. Co., 12, 13 and	36
Juengst & Sons, George	66
Kearney & Trecker Co.	71
Kelly Co., R. A.	71
Kempsmith Mfg. Co.	22
Knight Machinery Co., W. B.	69
Krieger Tool & Mfg. Co.	75
Landis Machine Co.	69
Landis Tool Co.	45
Lapointe Machine Tool Co.	70
Lea Equipment Co.	72
LeBlond Machine Tool Co., R. K. 4th cover	
Lincoln Williams Twist Drill Co.	86
Link Belt Co.	66
Lodge & Shipley Machine Tool Co.	4
Long & Allstatter Co.	71
Lumen Bearing Co.	80
Lunkenheimer Co.	66
Lyon Metallic Mfg. Co.	92
Manning, Maxwell & Moore, Inc.	78
Manufacturing Equipment and Engineering Co.	94
Manville Bros. Co.	17
Manville Machine Co., E. J.	63
Maris Bros.	78
Marshall & Huschart Mch. Co.	91
Massachusetts Saw Works	58
McCabe, J. J. 24 and	90
Merritt, Jos.	36
Merritt & Co.	87
Metal Hardening Solution Co.	80
Milton Mfg. Co.	64
Mitts & Merrill	59
Morse Chain Co.	67
Morse Twist Drill & Mach. Co.	47
Morton Mfg. Co.	87
Mossberg Wrench Co.	79
Motch & Merryweather Machinery Co.	91
Mueller Mach. Tool Co.	69
Mummert, Wolf & Dixon Co.	74
National-Acme Mfg. Co.	94
National Machinery Co.	81
New Britain Machine Co.	68
New Haven Mfg. Co.	56
New Process Raw Hide Co.	83
Newton Machine Tool Works, Inc.	11
Nicholson & Co., W. H.	59
Nicholson File Co.	17
Niles-Bement-Pond Co., 31, 32, 33, 34 and	90
Nolte Brass Co.	74
Northern Electrical Mfg. Co.	84
Northern Engineering Works	78
Norton Co.	57
Norton Grinding Co.	56
Nuttall Co., R. D.	82
Obermayer Co., S.	80
O. K. Tool Holder Co.	74
Owen Machine Tool Co.	22
Parker Co., Chas.	62
Pawling & Harnischfeger	78
Paxson Co., J. W.	81
Philadelphia Bourse	72
Philadelphia Gear Works	82
Phosphor Bronze Smelting Co.	80
Pittsburg Auto. Vise & Tool Co., Ltd.	62
Potter & Johnston Mach. Co., 20 and	21
Powell Tool Co.	87
Pratt Chuck Co.	76
Pratt & Whitney Co. 2 and	3
Prentice Bros. Co.	27
Prentiss Tool & Supply Co.	90
Q. C. Machine Tool Co.	75
Reed Co., F. E.	45
Reed Mfg. Co.	62
Reichheim & Co., E. P.	73
Reynolds Machine Co.	75
Rivett Lathe Mfg. Co. 3d cover	
Rockford Drilling Mach. Co.	93
Rock Island Tool Co.	62
Rockwell Furnace Co.	75
Rockwood Mfg. Co.	78
Rogers & Hubbard Co.	80
Rogers Wks., John M.	71
Root Co., C. J.	81
Roth Bros. & Co.	85
Safety Emery Wheel Co.	59
Saunders Sons, D.	94
Sawyer Gear Wks.	82
Schieren Co., Chas. A.	70
Schmitz, August	72
Schuchardt & Schutte	73
Schumacher & Boye	9
Screw Machine Products Corp.	86
Sebastian Lathe Co.	25
Sellers & Co., Inc., Wm.	30
Seneca Falls Mfg. Co., 64 and	92
Shelby (National Tube Co.)	80
Shepard Electric Crane and Hoist Co.	79
Shultz Belting Co.	79
Sibley Mch. Tool Co.	70
Simonds Mfg. Co. 74 and	75
Skinner Chuck Co.	76
Slate Machine Co., Dwight	69
Sloan & Chace Mfg. Co., Ltd.	47
Slocomb Co., J. T.	72
Smith, Chas. F.	74
Smith Countershaft Co.	29
Smith & Mills	87
Smith Co., Wm. J.	65
Spacke Mach. Co., F. W.	89
Springfield Mach. Tool Co.	15
Standard Connecting Rod Co.	73
Standard Engineering Wks.	75
Standard Gauge Steel Co.	83
Standard Tool Co.	56
Standard Welding Co.	61
Stark Tool Co.	87
Starrett Co., L. S.	51
Stoever Fdry. & Mfg. Co.	75
Straley & Hasbrouck	87
Sturtevant Co., B. F.	26
Tabor Mfg. Co.	73
Tate, Jones & Co.	61
Taylor & Fenn Co.	72
Taylor-Wilson Mfg. Co.	83
Toomey, Frank	92
Triumph Electric Co.	85
Trump Bros. Machine Co.	75
Tudor Mfg. Co.	72
Union Twist Drill Co.	53
Universal Machine Screw Co.	63
U. S. Electrical Tool Co.	85
U. S. Gas Furnace Co.	75
Van Dorn & Dutton Co.	83
Van Dorn Elec. & Mfg. Co.	87
Vandyck Churchill Co.	64
Vitrified Wheel Co.	58
Von Wyck Mach. Tool Co.	87
Wagner Elec. Mfg. Co.	85
Walcott & Wood Mach. Tool Co.	74
Waltham Watch Tool Co.	92
Ward & Sons, Edgar T.	80
Warner & Swasey Co.	92
Warner Instrument Co.	69
Waterbury Farrel Fdry. & Mach. Co.	68
Watson-Stillman Co.	63
Westcott Chuck Co.	77
Western Electric Co.	85
West Haven Mfg. Co.	74
Westmacott Gas Furnace Co.	74
Whitcomb - Blaisdell Machine Tool Co.	19
Whitman & Barnes Mfg. Co.	53
Whitney Mfg. Co.	41
Whiton Machine Co., D. E.	76
Wiley & Russell Mfg. Co.	73
Williams & Co., J. H.	86
Williamson Vise Co.	62
Wilmarth & Morman Co.	58
Woodward & Powell Planer Co.	87
Worcester Machine Screw Co.	74
Wormer Machinery Co., C. C.	91
Yale & Towne Mfg. Co.	79

Classified Index to Articles Advertised

Abrasive Materials

Abrasive Material Co., Phila., Pa.
American Emery Wheel Co., Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Dickinson, Thos. L., New York.
Norton Co., Worcester, Mass.
Pittsburg Emery Wheel Co., Pittsburg, Pa.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Air Lifts

Ingersoll-Rand Co., New York.

Alundum

See Grinding Wheels.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.

Arbor Presses—*Continued.*

Marshall & Huschart Machinery Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Arbors

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.

Arbors—*Continued.*

Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Union Twist Drill Co., Athol, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Balancing Ways

Bowsher Co., N. P., South Bend, Ind.